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TEXAS AGRICULTURAL EXPERIMENT STATION

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
W. B. BIZZELL, President

THIRTY-FOURTH ANNUAL REPORT

1921

IMPERIAL BUREAU
14 MAR. 1923
OF MYCOLOGY

B. YOUNGBLOOD, DIRECTOR,
COLLEGE STATION, BRAZOS COUNTY, TEXAS

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†As of November 1, 1921.
*In cooperation with School of Veterinary Medicine, A. and M. College of Texas.
**In cooperation with United States Department of Agriculture.

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B. YOUNGBLOOD, DIRECTOR

INTRODUCTION

Research involves the systematic study of a problem. The end-products of research are facts. It is obvious that any research agency must carefully plan its work and accurately record and digest the results obtained, if the work is to yield new scientific facts. Facts, and not theories or mere observations, form the only sound basis for our State and National welfare. Our farmers are not in need of theories or casual observations about agriculture. Facts, or accurate bodies of knowledge, relating to agriculture are in great demand, and must be available if we shall be able to build permanently. The function of the Texas Agricultural Experiment Station system is research in agriculture for the development of such facts and knowledge.

Money expended for agricultural research is an investment in the nature of a cold-blooded business enterprise. No good business man would think of engaging in any business without some knowledge or facts upon which to base his business policies, and every good business man who has had any immediate contact with agriculture is well aware of the fact that here is a field that is more circumscribed by a lack of definite knowledge than perhaps any other business. This is true because the successful practice of agriculture is dependent upon many and varied factors, including climatic conditions, the soils and their management, and economic conditions. It is pretty generally conceded that the farmer may be materially affected on his farm by the happenings on the other side of the world.

The Texas Agricultural Experiment Station system is the research department of the Agricultural and Mechanical College of Texas, and has been in operation thirty-four years. It has rendered many services to the citizenship of this State. The development of the Station has not been in the nature of a mushroom growth, for it has been slow and steady, as perhaps is best for this or any other kind of enterprise. It is a conservative agency and must necessarily be, inasmuch as its products must be reliable.

The Texas Station system at the present time consists of a central or Main Station at the Agricultural and Mechanical College of Texas at College Station, and thirteen outdoor field laboratories, or substations, in the several agricultural regions of the State, as well as four regional outdoor beekeeping field laboratories situated in appropriate regions. This organization allows the intelligent study of the various agricultural problems in the State under the conditions existing in the different regions where the respective problems are encountered.

The work is now carried on through eleven divisions of effort which take up and study the problems in their respective fields and conduct

their researches in both indoor laboratories and outdoor field laboratories. For convenience, the detailed results secured by these several divisions are given by lines of work in the following pages.

DIVISION OF VETERINARY SCIENCE

Projects under way:

(1) Swellhead of Sheep and Goats.
(2) Swamp Fever of Horses and Mules.
(3) Stomach Worms of Sheep and Goats.
(4) Loin Disease of Cattle.
(5) Texas Fever Immunization.

Swellhead:

This disease is fully described in the Thirty-third Annual Report of this Station, page 5. Up to the present time it has not been possible for our veterinarians to transmit this disease in any form or by any means. Negative results attended attempts to infect healthy goats by injections of serum, blood, and organic extract from sick goats. Healthy goats confined with sick animals remained unaffected. A number of healthy goats, constituting a "poison squad," forced to feed upon certain suspected plants, gave negative results. Of 81 cases of swellhead observed, 74 died.

Swamp Fever:

The apparent success in transmitting Swamp Fever by the bite of the stable-fly, given in the Thirty-third Annual Report, was not substantiated this year. The animal has not shown any more fever reaction for a full year following the fever reaction reported in 1920.

An attempt to pass the virus of Swamp Fever through pigs gave negative results. Experiments were conducted to find the spirochaete reported by a Japanese commission as the cause of this disease, but without success.

Stomach Worms:

The copper sulphate treatment for stomach worms of goats, yielding unsatisfactory results in 1920, was found to be 100 per cent. efficient when the dose was increased to three grams. In two-gram doses, efficiency of 92 and 70 per cent., respectively, was noted in two cases. Access to feed and water before and after dosing reduced the efficiency. In one experiment, where the animal was given two grams and had free access to feed and water immediately before and after dosing, zero efficiency was obtained. In an experiment where the animal was deprived of feed and water for 24 hours previously to dosing with three grams and allowed free access to water two hours afterward, zero efficiency was noted. Effective dosing was secured when the animals were deprived of feed and water for 24 hours before and 20 to 24 hours after administration of the copper sulphate. The efficiency of the dose was studied by sacrificing the goats and noting whether or not the stomach worms were dead.

Three grams of sulphate given to a sheep which had been deprived of feed and water for 24 hours, killed the animal. Another sheep, given 1½ grams, 24 hours after feeding and watering, was sacrificed 20 hours after dosing, and zero efficiency was noted.

Loin Disease:

The symptoms of loin disease of cattle are described on page 8 of the Thirty-third Annual Report. A suspected organism was found in smears taken from animals affected with this disease. This, however, was the only substantial progress noted during the year in the investigations under this project.

DIVISION OF CHEMISTRY

Projects under way:

(1) Soils Studies—The relation of the phosphoric acid of the soil to pot experiments, the relation between the production of nitrates and the results of pot experiments, and the relation between the potash removed by crops and the potash in the soil.

(2) Nutritive Values of Feeds.

(3) Soils—Composition and Chemical Analysis.

(4) The Needs of Texas Soils for Sulphur.

(5) Feed Control Service Analytical Work; State Fertilizer Control; and Miscellaneous Analyses.

Soils Studies:

The relation of the phosphoric acid of the soil to pot experiments was reported upon in Bulletin No. 267. This work showed that there is a closer relation between the active phosphoric acid of the soil and the results of pot experiments than there is between total phosphoric acid of the soil and pot experiments.

Work on the relation between the production of nitrates and the results of pot experiments is reported in Bulletin No. 283. It is shown that there is a close relation between the amount of nitrates produced in the soil and the amount of nitrogen taken up by the crops in the pot experiments, and that the amount of nitrogen removed from the soil by crops is reflected in the decrease in the amount of nitrates produced by the cropped soil.

Systematic laboratory studies were made on the relation between the potash removed by crops and the potash in the soil. The effect of cropping upon the soil was also studied.

Nutritive Values of Feeds:

Digestion experiments were conducted with special attention to wheat by-products and oat by-products, in an investigation of the nutritive values of feeds. The results are discussed in Bulletins No. 282 and 291. Work on the digestibility of the sugars, starches, pentosans, and remaining constituents of the nitrogen-free extract, is reported in Bulletin No. 290. The pentosans vary in digestibility, and the remainder of the nitrogen-free extract is not as digestible as the sugars and starches. In the case of concentrated feeding stuffs the sugars, starches

and pentosans account for nearly all of the nitrogen-free extract, but such is not the case with roughages.

Soils—Composition and Chemical Analysis:

Analyses of soils from Bell, Jefferson, Smith, Taylor, and Webb counties were made, and a bulletin is in course of preparation, giving the results.

Needs of Soils for Sulphur:

Pot experiments and laboratory work were conducted on the needs of Texas soils for sulphur. The results so far show that Texas soils probably have little or no need for sulphur as fertilizer. Phosphoric acid, potash, and nitrogen are needed to a much greater extent than sulphur, and when they are supplied they usually carry enough sulphur with them. A bulletin is now being prepared which will report the results of this work.

Feed Control, Fertilizer Control, and Miscellaneous Analyses:

Under the investigation of feeds, a method for estimating the salt content of feeding stuffs was devised and published in Bulletin No. 271. A study of the chemical composition of Texas honey and pecans was reported upon in Bulletin No. 272, and a discussion of the composition and value of wheat by-products, sifting tests for wheat by-products, the composition of the siftings, the productive values of wheat by-products, and the relation between feeding experiments and productive values, is contained in Bulletin No. 282.

The Chief of the Division of Chemistry is *ex officio* State Chemist and as such is charged with the enforcement of the State fertilizer law. Analyses of commercial fertilizers for the year are reported in Bulletin No. 280.

The Division of Chemistry also does the analytical work for the Feed Control Service, and in addition makes a large number of miscellaneous analyses each year.

DIVISION OF HORTICULTURE

Projects under way:

(1) Plant Breeding, Using Blackberries, Dewberries, and Raspberries (genus *Rubus*).
(2) Longevity of Indian Cling Peach.
(3) Comparison of *Vitis vinifera* Grapes with Native or *Vitis champinii* Stock.
(4) Orchard for Testing New Fruits.
(5) Arboretum for Testing New Trees.

Plant Breeding With Berries:

Selections were made of ten different plants of a cross between the dewberry and the red raspberry. This creation has been named the "Ness Berry," by the President and the Board of Directors of the College, in honor of the originator, H. Ness, Chief of the Division of Horticulture. The increase plants, 751 in number, were distributed among

interested growers in various parts of the State. The Ness Berry promises to become of considerable economic importance in Texas, and is much sought by people in and out of the State. Breeding is also in progress with four other promising crosses of the dewberry, in an effort to further improve the fruit.

Longevity of the Indian Cling Peach:

The orchard which has been maintained for the study of the Indian Cling peach is now dying out rapidly, without having yielded positive results. The only trees producing peaches during the year, however, were the Indian Clings, which appeared to be more capable of withstanding the very unsuitable soil than any other race.

Comparison of European and Native Grapes:

The vineyard for the comparison of the vitality and longevity of *vinifera* varieties of grapes upon their own roots with the same varieties grafted onto the native *Vitis champinii,* has not yielded much in the way of definite results this year, for the reason that nearly all the vines have died out. The indications are, however, that the grafted vines are both the hardier and more prolific.

Testing New Fruits:

The Methley plum trees, obtained from the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture in 1915, are of excellent vigor, but gave no fruit the past year. The jujubes, from the same source, planted in 1918, are very vigorous, free from disease, and have borne three crops of fruit, the last two being as heavy as could be desired.

Testing New Trees:

Oaks were used in the tree-breeding work. First-year hybrids have been secured from crosses of overcup, swamp whiteoak, and postoak as the male parents, and liveoak as the female parent. Some of these young trees were planted out, while the others remain in the nursery. The variability of the second generation is astounding, as it ranges from the pure type of the original male to that of the original female parent with all grades of relationship and some undefinables intervening. This work gives promise of yielding most interesting scientific and economic results.

The arboretum is being constantly added to and now contains many species of trees, and will serve as an index to what trees ought to be grown in this section of the State, for various purposes. More than 100 young long-leaf pine trees were planted out during the year. So far, this is the only species of pine that has escaped the depredations of the pith borer in this locality. From indications given by the two specimens left from seed planted in 1915, it is one of the few forest trees able to make a normal growth in the soil here, and for this reason efforts will be made to rapidly increase the species.

DIVISION OF ANIMAL INDUSTRY

Projects under way:

(1) Comparative Merits of Corn Versus Grain Sorghums for Fattening Baby Beeves.

(2) Cross Breeding a Three-Quarter Blood Brahma Bull on High-grade Hereford Cows.

(3) Grading Up a Herd of Jersey Dairy Cows.

(4) Comparison of the Feeding Value of Cottonseed Meal, Cotton Seed and Tankage, and Supplements to Milo Chops, in a Fattening Ration for Hogs.

(5) Study of the Results of Feeding Rations of Milo Chops, Milo Chops Supplemented with Tankage, and Milo Chops Supplemented with Tankage and Pasture When Fed to Growing Pigs.

(6) Study of the Comparative Gain and Economy of Gain Made by Lambs Fattened on Grain Sorghums Versus Corn.

(7) Adaptation of the Corriedale Sheep to Southwestern Texas (in Cooperation with Bureau of Animal Industry).

(8) An Economic Study of Shearing Sheep Once Versus Twice a Year.

(9) Insects and Parasites Affecting Livestock (in cooperation with Bureau of Entomology).

(10) A Study of Inheritance of Characters in Sheep Breeding.

(11) Wool Scouring and Grading.

(12) Study of the Improvement of Type in the Angora Goat.

(13) Study of Cryptorchidism in Goats.

(14) Comparison of Cottonseed Meal with Animal Protein as a Feed Supplement for Laying Hens.

(15) Breeding as Affecting Egg Production.

Corn Versus Grain Sorghums for Fattening Baby Beeves:

Ground corn and cob meal, shuck included, ground feterita heads, and ground milo heads were used in this experiment. Cottonseed meal with 43 per cent. protein was used with each feed on a pound-for-pound basis. Alfalfa hay and sorghum fodder were used as roughages. Forty-five high grade Hereford calves were divided into three lots of 15 each and fed for 165 days. All three lots made exceptionally good gains throughout the period. The corn-fed lot made gains not quite so large as were made by the feterita-fed lot, but put on a smoother finish and sold at 25c per 100 pounds higher than the calves from the other two lots. The beeves were sold at Fort Worth on the basis of Chicago prices, and the packer's manager stated that the cattle were of a better quality and carried a better finish than anything that had gone over the scales at Fort Worth during the year. The results of this work are reported in Bulletin No. 296.

Brahma-Hereford Cross:

A three-quarter blood Brahma bull, donated by Hon. A. P. Borden, of Pierce, Texas, was used in comparison with a registered Hereford bull in an experiment to determine which would get the better offspring from high grade Hereford cows. Fifteen calves were secured from

the Brahma-Hereford breeding, and at five months of age they outweighed the calves from the straight Hereford breeding from 30 to 40 pounds per head. This investigation will necessarily have to be continued for a period of years before definite conclusions can be drawn.

Grading Up a Jersey Dairy Herd:

The Station maintains a herd of about 50 Jersey dairy cattle, one-half of which are registered animals. Two registered bulls with breeding of national recognition head the herd. Purebred heifer calves and the best grade heifer calves are retained as are the choicest purebred bull calves, for distribution among breeders and additions to the herd. This policy in connection with the culling of low-producing individuals is expected to develop a purebred dairy herd of high production and form foundation stock for the production of high-class animals for distribution and for dairy research.

Comparison of Cottonseed Meal, Cottonseed and Tankage, as Supplements to Milo Chops, in a Fattening Ration for Hogs:

Cottonseed meal, cottonseed and tankage were used as supplements to milo chops in a fattening ration for hogs, for comparison of their relative feeding values. Incidentally a test was made to determine whether a ration one-fourth of which was cottonseed could be used for fattening hogs without fatal results and a determination of the amount of mineral mixture which will be consumed by hogs on different rations was undertaken. Thirty head of Duroc-Jersey hogs, averaging around 65 pounds each, were divided into three lots of 10 each, and fed for 120 days. The lot fed on milo chops and tankage was the only one that fed out at a profit over the cost of feeding and selling charges. The lot fed on cottonseed meal showed a tendency to scour, and one hog died from cottonseed meal poisoning. The lot intended for the cottonseed ration refused to eat it, and cottonseed meal and tankage were substituted. The mineral used was 1½ bushels of charcoal, 10 pounds of ashes, four pounds of salt, four pounds of lime, and two pounds of copperas. The lot fed on the tankage ration used the smallest amount of the mineral mixture, owing perhaps to the fact that tankage is high in ash content. The lot with cottonseed meal only as a supplement consumed the greatest amount of the mineral mixture. All three lots killed out firm.

Feeding Hogs on Milo Chops, Milo Chops Supplemented with Tankage, and Milo Chops Supplemented with Tankage and Pasture:

Duroc-Jersey sows and pigs of even condition were used for the three different rations. Lot 1 was fed on milo chops on dry-lot. Lot 2 received nine parts milo chops and one part tankage, on dry-lot; Lot 3 was fed nine parts milo chops and one part tankage, and grazed on Sudan grass and oats pasture. Lot 1 was later subdivided and half of the pigs put on pasture at weaning time. The group kept on dry-lot after weaning lost $6.37, while the group given pasturage gained $6.21. Lot 2 made a gain of $5.63, while Lot 3 made the highest gain—$15.62. This test unquestionably points to the value of a balanced ration, and to the unusual value of grazing in addition.

A 25-day test was conducted of weaning pigs in connection with the self-feeder, for the purpose of determining what proportion of concentrates they would consume from free choice. Fifty-one pigs were used. Self-feeders containing milo chops, shorts, and tankage were placed before the pigs, and they continued their growth after weaning without the slightest change. The proportion in which they selected their feed was very nearly the same as the mixture fed to sows and pigs not in the test, and used as a check.

A self-feeder free-choice test was made with 150-pound gilts and barrows, using milo chops, cottonseed meal, and tankage. The test indicated that the hogs prefer tankage over cottonseed meal.

Grain Sorghums Versus Corn for Lamb Fattening:

Seven lots of 20 each and one lot of 15 Rambouillet-Delaine lambs were fed 90 days on rations composed of the several grain sorghums and corn in varying combinations, to compare corn with grain sorghums for a study of the ecenomy of gains. The experiment and its results are fully described and discussed in Bulletin No. 285. Ground threshed milo made the best showing.

Corriedale Sheep for Southwestern Texas:

In cooperation with the Bureau of Animal Industry of the United States Department of Agriculture, a study is being made of the adaptation of the Corriedale sheep to the ranges of Southwestern Texas. The work is being done at Substation No. 14, near Sonora. The Corriedale breed will be compared with registered Rambouillet handled under similar conditions. Special attention is being given to prolificacy, hardiness, maturity, weight, and quality of fleece, quality and shearing value of wool, shrinkage of wool as result of scouring process, grazing qualities of the sheep, susceptibility to diseases and animal parasites, and mutton qualities. Lambs from the Corriedale ewes made exceptional growth during the summer months. The study will be continued over a period of years.

Shearing Sheep Once Versus Twice a Year:

Shearing tests indicate that sheep sheared twice a year will produce approximately one pound more wool per annum than those sheared only once, that fall-sheared ewes drop no more lambs than those sheared once a year; that muttons sheared twice a year gained two pounds per head more than those sheared only once. Considering extra costs of the twice-a-year shearing, and the slight advantages gained, twice-a-year shearing is not thus far shown profitable.

Insects and Parasites Affecting Livestock:

A project on insects and parasites affecting livestock, and a subproject on the screw-worm and the wool maggot, are in progress at Substation No. 14 and vicinity, in cooperation with the Bureau of Entomology of the United States Department of Agriculture. Experiments are under way to control the screw-worm through systematic and thorough destruction of the carcasses, the trapping of flies, the poisoning of flies, avoiding causes of infestation such as dehorning, castrating

and branding during the screw-worm season; systematic destruction of ticks; protection of animals against unnecessary wounds; a study of the type of wounds in relation to the infestation by screw-worms and other dipterous larva on livestock; a study of the effect of larva on the host; treatment of wounds previously infested with screw-worms, to note the action of various chemicals and compounds on the larva in living tissues; seeking best method of combating the wool-worm or maggot, and a study of the effectiveness of repellants against infestation of wounds with screw-worms on sheep, goats, and cattle. Circular No. 25 recites the results of the investigations on the screw-worm and the wool maggot, and Circular No. 28 discusses internal parasites affecting sheep and goats.

Fly-traps used in the war against the blow-fly proved effective and the ranchmen are using them freely.

Inheritance of Characters in Sheep Breeding:

The Karakule sheep being used in the effort to produce a fur-bearing breed of sheep now number four rams and 18 ewes. Definite data have not been obtained in the study of fur-characters. Sundry crosses to produce a mutton breed better adapted to Texas conditions are without definite results as yet.

Wool Scouring and Grading:

The wool and mohair grading- and scouring-plant, provided for by special act of the legislature, was placed in operation during the year, under the direction of a trained wool- and mohair-grading and-scouring expert. More than 2500 pounds of wool was scoured out during the portion of the season the plant was in operation. The plant is equipped with the very latest and best of improved machinery. Samples of fleeces taken in accordance with instructions furnished by the Station are received at the plant, graded, sorted, and scoured. In due time a report is sent to the grower showing the grade, shrinkage, spinning count, and yield of scoured wool or mohair, and instructions are given for the improvement of fleeces by better matings and better methods of shearing and handling the wool and mohair.

Improvement of the Angora Goat:

An experiment is in progress at Substation No. 14, using choice types of purebred Angora goats in the effort to produce a better type through scientific breeding.

Cryptorchidism in Goats:

A systematic study of the inheritance of cryptorchidism is under way with the object of finding out how best to eliminate this defect. Cryptorchids, otherwise known as ridglings or terunas, are especially frequent among angora goats, but occasionally occur in all mammals. To successfully castrate the ridgling requires a rather difficult surgical operation which the average ranchman does not care to undertake, and he always dreads to encounter one while castrating his surplus bucks. Corrective matings have been made and observations recorded. The project will require considerable time to yield definite results.

Comparison of Cottonseed Meal with Animal Protein Feeds for Laying Hens:

A test was made comparing cottonseed meal with tankage in the ration for laying hens. For a comparison of animal protein with vegetable protein feeds, fish meal was considered, but tankage was found much cheaper in the market and was selected as the source of animal protein. The four lots of hens produced approximately the same number of eggs during the duration of the test. Cottonseed meal was used in graduated proportions, ranging from 19 pounds with 85 pounds of tankage to 63 pounds with 50 pounds of tankage. It was found that the higher the cottonseed meal content, the cheaper the price per pound of the ration, but the more required for the production of one dozen eggs. No one ration, however, showed any appreciable superiority over the others.

Breeding as Affecting Egg Production:

During the year a project was begun to determine the effect of breeding on egg production. A study is being made of the effect of line-breeding and of whether the size of the egg of common farm chickens can be increased by the use of well-bred cocks. A large number of measurements and observations were made on 140 pullets in a study of culling for egg production.

DIVISION OF ENTOMOLOGY

Projects under way:

(1) A Bionomical, Morphological, and Systematic Study of Aphids.
(2) A Biological Study of the Family Tachinidae.
(3) Study of Insects Affecting Cotton.
(4) Study of the Sweet Potato Weevil.
(5) Study of Peanut Insects.
(6) Experimental Apiaries.
(7) Foul-Brood Eradication.

Study of Aphids:

Scientific equipment was secured for use in the study of aphids, including a Freas Constant Temperature and Humidity oven. Studies are being made on the effect of temperature and humidity upon the production of the winged and the wingless forms and of the sexual and parthenogenetic forms of aphids, and upon color variations. Control measures for the cotton or melon louse, however, were studied under the project on insects affecting cotton.

Biological Study of the Family Tachinidae:

There are certain insects which prey upon other insects and are, therefore, often helpful to the farmer. The *Tachinidae* comprise a family of these parasitic insects, and the Station is studying those species of this family which are found in Texas, to note their distribution and their effect upon harmful insects. The tachinid flies were generally rare during most of last summer. Six new species, however, were found, and described for the first time in a scientific paper. This

year fifteen breeding records on the species studied were taken, an account of which was published.

Cotton Insects:

Circular No. 29 was issued during the year, discussing dusting for the control of the boll weevil. It was found that the boll weevil can be controlled by dusting with calcium arsenate, but further work will be necessary to determine just what conditions will make it profitable to poison.

A heavy infestation of the cotton louse was controlled by dusting with nicotine sulphate dust. This insect rarely damages cotton to a considerable degree, but it frequently is disastrous to melons and kindred crops. The possibility of its control, therefore, with nicotine sulphate dust or "Black-leaf 40," the liquid form, is of importance.

Sweet Potato Weevil:

Investigations on this project have been completed and a bulletin is in preparation which will give the results secured. Natural control measures, such as crop rotation and the use of slips free from insects, are indicated.

Peanut Insects:

This project has been discontinued because it was found that no damage is resulting from this cause that would justify further research at this time.

Experimental Apiaries:

Apiary No. 1, College Station: About half of the 22 colonies came through the winter short of stores and very weak. Early feeding and manipulation brought all colonies to swarming strength by June 1. The honey crop was a total failure, and swarming profuse, but by careful manipulation the number of colonies was kept within the capacity of the apiary, and 23 full, strong colonies were on hand at the close of the year. The apiary was completely re-queened with experiment stock from the Station's queen yard during the summer. Special recording instruments were installed for a study of the fluctuations in the weight of a normal colony of bees under varying weather conditions. Nearly 40 samples of honey from different sections have been collected, to show the several representative types produced in Texas.

Apiary No. 2, Dilley: About 2000 pounds of honey of fine quality was produced from the 40 colonies in this apiary. By reversing new brood frames during the pupation of the first crop of bees, satisfactory results were secured in the prevention of sagging of the combs. Similar results were secured in a similar test at Apiary No. 1.

Apiary No. 3 (Queen Yard), San Antonio: On account of unfavorable weather conditions during March and April, only 250 queens were reared. From 50 to 65 nuclei were in operation at various times. A few of the queens were exchanged for other promising queens and the remainder distributed among the beekeepers of the State. Careful study was made of methods and technique of queen-cell production and

queen management and of the effect of honey flows upon the cell-building instinct. The queen-breeding season ended with 25 strong colonies of excellent type on hand, together with enough equipment to establish 120 queen rearing nuclei next spring. It is planned to make a careful study of inheritance of various qualities in the honey bee.

A study of the regional differences in soils, temperatures, rainfall, and flora indicates the need for experimental apiaries situated in each typical region of the State to determine the particular management best adapted to bees for the several beekeeping sections.

Foul Brood Eradication:

The Director of the Station is charged with the enforcement of the State law for the eradication of foul brood in bees, and through the Division of Entomology maintains a corps of inspectors for the systematic examination of all bee colonies in the State and with power to order the treatment or destruction of colonies found to be infested with foul brood. Inspections were conducted in 55 counties during the year. A total of 39,741 colonies examined revealed 499 colonies affected with foul brood, 60 of which were treated and 439 destroyed.

Cooperative Projects:

Spraying for San Jose Scale: Tests with commercial sulphur products as dormant sprays for the control of San Jose scale gave excellent control in every case, indicating the value of commercial products as against the home-made lime-sulphur mixture. This work was done in cooperation with the Extension Service.

Scale Insect Collections: In cooperation with Leland Stanford University, a collection of more than 100 species was secured by Professor G. F. Ferris, from representative parts of Texas. These species have been added to the Station's collection for study.

Pecan Case-Bearer: In cooperation with the Department of Entomology of the College, the pecan case-bearer study is being continued. The life-history of this insect has been practically completed, and will be reported during the coming year. Control measures for this insect are practically assured by the spraying tests with arsenate of lead (3 pounds to 50 gallons of water), still further confirming previous results.

DIVISION OF AGRONOMY

Projects under way:

(1) Oat Improvement.
(2) Rotations, Fertilizers, and Soil Improvement.
(3) Plant Introduction Studies.
(4) Crop Variety Tests.
(5) Time and Method of Intertillage Studies.
(6) Time and Method of Seedbed Preparation.
(7) Crop Improvement Studies.
(8) Studies of the Rate of Distribution of Seed and Time of Thinning Cotton.

(9) Selective Inbreeding in Grain Sorghums.
(10) Study and Improvement of the Peanut.
(11) Composting Raw Rock Phosphate and Sulphur with Different Soils.
(12) Rice Improvement and Methods of Production.
(13) Wheat Investigations and Improvement.

Oat Improvement:

This project was continued at the Main Station and at Substations Nos. 5, 6, and 12, where further testing of varieties from pure-lines was done. Most of the work, however, centered at Substation No. 6, Denton, where an attempt is being made to assemble a large group of varieties representing the Texas Red Rustproof and similar types of oats. A considerable quantity of each of several pure-line selections was increased from last year's head-to-row nursery, many of these being in rod-square and larger plats and showing 30 to 100 per cent. increase in yield. A very severe rust epidemic was encountered and much opportunity afforded for selection. No varieties were found to be rustproof. Very little winter-killing occurred in the fall-planted material used.

Rotations, Fertilizers, and Soil Improvement:

Miscellaneous work under this project was continued at the Main Station and ten of the substations. Considerable reduction in root rot infestation was noted in the rotation of cotton plats at Substation No. 5, Temple. No other striking progress was made at any point.

Plant Introduction:

Progress was noted with several new or little known legumes and grasses. Black medic, sweet clover, and various other clovers were thoroughly tested at all the substations, with some remarkably favorable results on the limestone soils in the central part of the State. Guar, which has been making a favorable showing as a legume resistant to root rot, was distributed quite extensively in the central part of the State.

Crop Variety Tests:

Considerable reductions were made in the numbers of varieties of corn and cowpeas carried in these tests, and improved or selected strains of the most successful varieties were introduced. Bulletin No. 276 and Bulletin No. 274 discuss the results of this work.

Time and Method of Intertillage:

Time and method of intertillage studies were continued at Substations Nos. 1, 7, 8, and 12, with the result that previous observations were largely confirmed and a further showing was made that the presence or absence of weed growth is perhaps of more importance than the exact nature of the soil mulch obtained by cultivation.

Time and Method of Seedbed Preparation:

These studies were continued without notable results.

Crop Improvement Studies:

Spur feterita continues to be very popular. Bulletin No. 275, which

gives the results of the work with this crop, has been very much in demand.

Rate of Distribution of Seed and Time of Thinning Cotton:

The results secured in this study continue to indicate that late thinning is harmful rather than beneficial and that where the moisture supply is adequate and the cultivation is also adequate and there is absolute freedom from competing weeds and grasses, cotton may be left much more thickly in the row than is usually done. Many of the best yields have been secured with rates as thick as from 6 to 12 inches apart in three-foot rows. Sometimes the yields continue good up to distances as wide as 24 inches apart; with considerable irregularity, however, in this respect.

Selective Inbreeding in Grain Sorghums:

Statistical data were published in Bulletin No. 279, showing a marked degree of purity and uniformity of character in the second and successive generations of inbred lines, thus emphasizing the value of head-to-row work in the improvement of grain sorghums. Blackhul Kafir 153, having been the highest yielding line for three generations, has been increased for distribution to farmers.

Study and Improvement of the Peanut:

Considerable increase was made of outstanding pure-lines, and distributed to interested growers.

Composting Raw Rock Phosphate and Sulphur with Different Soils:

Raw rock phosphate and sulphur studies were taken during the war at the instance of the National Defense Council, through the Federal Office of Experiment Stations. A special phase of this project was studied this year by applying sulphur and acid phosphate direct on the soils at Substation No. 5, Temple. The yield of cotton in 1920 showed a considerable increase from the use of sulphur. There was perhaps also some benefit in protection from root rot on the sulphur plats. In the 1921 crop this phase of the study was enlarged, and application of as much as 10,000 pounds of sulphur to the acre was made.

Rice Improvement and Methods of Production:

Due to inadequate finances, the rice improvement and methods of production tests have been largely suspended. The introduction of new varieties from the Philippines has been continued, for nursery tests. Among the Philippine varieties introduced in 1920, several made excellent showings. Four or five of the best pure-lines in the variety tests are now being increased on a large scale. The fertilizer experiments with rice have been continued, and sulphate of ammonia continues to give excellent results as a rice fertilizer.

Wheat Investigations and Improvement:

The wheat improvements investigations were undertaken during the year. There were 200 pure-lines of a Mediterranean type of wheat under test at Substation No. 5, Temple. At Substation No. 6, Denton,

520 pure-line strains of Mediterranean were under test and lesser numbers of several other types were being tested. A few of the Mediterranean selections are being carried in field plats for increase.

Seed Laboratory:

The cooperation between the Division of Agronomy and the Seed Laboratory of the Bureau of Plant Industry of the United States Department of Agriculture, whereby a branch seed laboratory is maintained at the Station, was continued throughout the year. A large number of tests of planting seeds were made by this laboratory for the farmers of Texas during the season.

DIVISION OF PLANT PATHOLOGY AND PHYSIOLOGY

Projects under way:

(1) Watermelon Diseases.
(2) Texas Root Rot.
(3) Soil Temperature Studies.
(4) Storage Rots of Onions and Irish Potatoes.
(5) Storage and Storage Diseases of the Sweet Potato.
(6) Tomato Diseases.
(7) Diseases of Spinach, Cabbage, and Lettuce.

Watermelon Diseases:

Due to storms during the summer season, the experimental watermelon crop at Prairie View was destroyed and only laboratory results were secured. A Diplodia fungus was located as the cause of the blossom-end rot and no essential difference could be discovered between this fungus and *Diplodia tubericola* which causes Java black rot of the sweet potato. Numerous cross inoculations of the Diplodia organism from the watermelon onto the sweet potato and of the sweet potato organism onto the watermelon indicated that the two strains are one and the same and may readily cross from one host to the other. This has a practical application in that watermelons should not follow sweet potatoes, nor sweet potatoes follow watermelons. Cross inoculations with the anthracnose fungus of watermelons, *Colletotrichum lagenarium,* onto many cucurbit hosts show conclusively that this fungus will readily infect cucumbers, cantaloupes, squashes, gourds, and citrons. This fungus from any and all of these hosts will readily cross and attack the others. The *Cercospora* spot of watermelon could not be studied this year, owing to the loss of the field crop.

Root Rot:

The root rot investigations this yar have tended to verify the assumption of the investigators that the fungus, *Ozonium omnivorum,* considered as the cause of the disease, lives over winter upon susceptible roots which may remain alive in the soil. This may explain why the disease hangs over in some soils from year to year in spite of deep plowing and crop rotation. A large number of plants were examined to determine which are susceptible to the disease. Rotation experiments

were continued at the Temple substation, and the value of rotations for reducing the root rot ravages is definitely indicated. Crop rotations to be effective, however, must probably include absolutely clean culture to prevent the growth of weeds and other susceptible plants during the time the grain and other non-susceptible plants are being grown in the rotations.

A full and comprehensive report of this work is now in course of preparation for publication.

Soil Temperature Studies:

Daily soil temperature data have been gathered at Prairie View, Troup, and Temple, in the hope of correlating the effect of soil temperature and weather conditions upon the prevalence or absence of plant-disease epidemics.

Storage Rots of Onions and Irish Potatoes:

Material was not available for experiments on the storage rots of onions. A fusarium from rotted stored Irish potatoes was persistently isolated and found to yield 100 per cent. infection when inoculated into healthy potatoes. A similarity was noted between this fusarium and the *F. oxysporium,* the cause of the wilt of Irish potatoes in the field. Distinct differences were noted, however, and further work will be necessary to determine if it is a species or merely a variety of *F. oxysporium.*

Three carloads of Irish potatoes were stored in the "A. and M." Sweet Potato house at Troup, and the loss from rots was very small, indicating that the sweet potato house which is used for sweet potatoes in winter is also useful for storing Irish potatoes during the summer.

Storage and Storage Diseases of Sweet Potatoes:

In cooperation with the Extension Service, plans and specifications for the construction of unit storage houses varying from 10,000 to 100,000 bushels capacity, have been worked out. This is an enlargement and modification of the sweet potato house known as the A. and M. sweet potato house, which has already demonstrated its success.

Tomato Diseases:

It has been found that the causal organism of tomato wilt, *Fusarium lycopersici,* is carried in every part of the plant, namely, the roots, stems, petioles, leaves, and calyx. The Fusarium was also isolated from the tomato fruit itself. One more step remains and that is to find out whether or not the seed carries the disease.

Diseases of Cabbage, Spinach and Lettuce:

A Fusarium wilt, *Fusarium conglutinans,* was found to be the most serious disease of cabbage in the Rio Grande Valley. Downy mildew, *Peronospora effusa,* was identified as the cause of the chief disease of spinach. It will be necessary to re-work the life-history of these diseases, as applicable to Texas conditions. An apparently new and undescribed disease, probably of bacterial origin, attacks the lettuce crops and manifests itself as a burning of the outer edges of the foliage. This burning penetrates clear through the head, attacking every leaf

of the plant, and appearing on the inner leaves of the head as numerous small spots. Several fungi and species of bacteria were isolated, but inoculation experiments have not yet been made.

The study of water treatment against algae has been carried on, rather incidentally to the projected work. No considerable headway has been made on the treatment, except that cultures obtained last year are still alive and represent a variety of genera and species.

The plant disease survey work is carried in co-operation with the Plant Disease Survey of the Bureau of Plant Industry of the United States Department of Agriculture. Monthly and final yearly reports are made of losses from plant diseases occurring among the economic crops of Texas.

DIVISION OF FORESTRY

Project under way:

(1) Introduction and Propagation of Forest and Shade Trees in Different Regions of Texas.

The greater part of the work in forestry has been done, as in previous years, at Substation No. 8, Lubbock. It was decided that a large variety of Chinese shade trees should be tried out and accordingly 21 species of Asiatic tree seeds were secured, of which nine were introduced for the first time and a number of the others were but slightly known in Texas. Eight species of European origin were ordered, besides 26 other species. A total of 55 tests during the year included the same species in test at more than one place. The plan of a year ago, the policy of distributing a limited number of trees to institutions, schools, and public organizations, was followed. A total of 9500 trees were distributed to nearly 600 different parties, located, for the most part, in West Texas. This distribution was made from the substations at Lubbock, Denton, Temple, and Spur. Lubbock can grow most of the varieties of trees desired for Western Texas, but there is a need for more trees along the Gulf Coast, where the winds often injure crops rather severely. Northern varieties of trees do not succeed in the coast country, and subtropical varieties offer a field for further experiments. In this connection, such trees as the Eucalyptus and the silk-oak are being tried out at Substation No. 1, Beeville. It is planned to make further importations from China, and also to secure a number of varieties and species of trees from various parts of the world.

Since the legislature entirely eliminated the small appropriation which has been previously allowed for forestry work, there will necessarily be no forestry research on the Station during the year 1921-22.

DIVISION OF COTTON BREEDING

Project under way:

(1) A Fundamental Study of Inheritance in Cotton.

One of the prominent projects of the Station is the testing each year of varieties of cotton in various parts of the State. The Main Station and nearly all of the substations are used in this work. It is sought to

keep in touch with the improvement of cotton varieties in this and other countries and to learn which types and varieties are best adapted to the different parts of Texas. Early tests simply sought to take a record of yield and the ginning turn-out. More recent tests have included a study of the effect of soil and climatic factors on the development and properties of the cotton plant and its products. A mass of records has been carefully taken and as far as it goes is highly valuable. Selective improvement of Belton cotton, a strain developed by the Station from a single plant found in a field of Rowden cotton in 1913, has been continued at Substation No. 5, Temple. Increase plats are being grown to insure the preservation of the true type resulting from successive selections. From a number of single plant selections made at the Main Station previously to 1920 and tested for their value as mothers of improved pedigreed strains, one strain coming from a plant of Lone Star (T. S. No. 3150) was increased during the year to 143 pounds. This will be increased still further for distribution as pedigreed seed. In the genetics studies with cotton, seeds for growing the first, second, and third generations of a number of crosses of No Lint, Acala, Durango, Lone Star, Texas Rust, Black-seed, Red-leaf, Rowden, Mebane, Yuma, King, and Sea Island were planted in the breeding ground at the Main Station with plats of the parental strains.

Studies were made and notes were taken* of the hybrids grown in 1920 and of the growing plants of the 1921 crop from these hybrids. These studies yielded several additions to our knowledge of heredity in cotton, including the inheritance of growth habit, seed coat (fuzz), percentage of lint, color of lint, color of foliage, length of lint, size of seed, and softness of lint. Two cases of linkage have been found. Crosses involving seed free from fuzz and low percentage of lint crossed with types having fuzzy seed and high percentage of lint produced a second generation in which the parental characters remained linked. A like linkage occurs between the cluster habit and red-leaf in the Texas Red-leaf variety of cotton.

DIVISION OF FARM AND RANCH ECONOMICS

Projects under way:

(1) Ranch Economic and Social Problems.

(2) Activities of the United States and Other States in Promoting Rural Progress.

(3) The Formation and Activities of Farmers' and Ranchmen's Organizations and Mutual Associations.

Ranch Economic and Social Problems:

Detailed reports from 121 ranchmen have been secured, giving in great detail the economic and social activities of the ranchmen as related to the ranch business. These ranchmen own or control about 2000 sections of land. A statistical study was begun on the schedules received from the 97 ranchmen operating ranches in Sutton County,

*This work was done by K. I. Thadani, of Bombay, India, a graduate student in the Agricultural and Mechanical College of Texas, and was the subject of his thesis for Master's Degree.

Texas, and utilizing 1504 sections of land. This is about the area of Sutton County, though some of the ranches studied extended across the county line, and some ranch lands in Sutton County were not studied. Additional valuable material was gathered from secondary sources, such as ranchmen's organizations, studies by other experiment stations and the reports of hearings before Congress, and so forth. An exhaustive report is in preparation for publication by the Station, giving the results of this study.

Rural Progress:

A collection of the laws of the different states in the Union relative to credits, co-operation, rural social organizations, rural planning, and land settlement, has been assembled. The Division's address is on the mailing list of similar divisions in other colleges and universities, all the bureaus and divisions in the United States Government, many of the state departments of agriculture, labor and commerce, and the leading farmers' organizations.

Farmers' and Ranchmen's Mutual Organizations:

A collection has been made of the constitution and by-laws of the leading organizations in and out of the State. The location of a number of local cooperative organizations in Texas was ascertained, and statements were secured of their problems and prospects. On the basis of information gathered, a preliminary statement has been written which discusses the fundamental principles involved in the various co-operative activities of farmers.

A model farm-lease form was prepared and distributed by the Division in answer to an urgent need of citizens in various parts of the State.

Circular No. 26, "Cost of Production; Its Relation to Price," was issued and distributed from this Division during the year.

A study of land tenancy under the plantation system was conducted in co-operation with the Office of Farm Management and Farm Economics of the United States Department of Agriculture. A detailed analysis was made of land tenure on plantations and a detailed description given of every phase of the tenant's life. Eighteen or twenty plantations were studied on which were found 300 tenants.

A second co-operative project with the Office of Farm Management and Farm Economics involved a study of land prices. The price of land as measured by land sales and the relation of the price of land to the rent of land were included. Records were secured in Dallas, Williamson, and Brazos Counties, Texas, covering the years 1910-1920. In Williamson and Brazos Counties study was made of such factors as type of soil, distance from market, as affecting the rent of land and the price of land.

DIVISION OF SOIL SURVEY

Soil survey work has been carried on continuously during the year, in cooperation with the Bureau of Soils of the United States Department of Agriculture. During the year detailed surveys of four counties have been completed, the reports written, and all maps made. The re-

ports will be published by the Bureau of Soils under the terms of the cooperative agreement with this Station. The counties completed during the year are Dallas, Erath, Tarrant, and Red River, comprising an area of approximately 38,884 square miles, or 2,485,760 acres. With the completion of these areas, field work was taken up in Harris, Coleman, Reeves, and Dickens counties, and it is planned to complete these surveys during the fiscal year of 1921-22. The total area in these four counties is approximately 6,606 square miles, or 4,227,840 acres. During the year the Texas Station has kept two soil surveyors in the field the entire time, while the Bureau of Soils has kept one man in the field all the time, and three men in the field for a little more than half the time.

FEED CONTROL SERVICE

The State law makes the Director of the Station responsible for the enforcement of the provisions of the pure feed law. For convenience, he has delegated the routine of this work to the Feed Control Service.

The feed law has been enforced during the year in a manner consistent with the needs of the Texas stockman and farmer, the annual publications have been issued, and the work has progressed smoothly. The activities of the Feed Control Service are largely of a regulatory nature, and a full and complete report thereof may be found in Bulletin No. 281.

SUBSTATIONS

The substations are essentially regional stations where the opportunity is afforded to conduct research in the environment where the problem presents itself.

There probably will never be quite enough of these substations to serve the demands of each progressive agricultural community, or to satisfy the essential traits of the investigator, who is sensitive to the smallest factor affecting his experiment, and in theory would like to make a test on each field where use is to be made of his findings; but it is only practicable to have these grounds at a relatively few places, owing to the cost of acquiring and operating them. Therefore, only those agricultural products of considerable economic importance can yet be served with these specific investigations.

Substation No. 1, Beeville:

Location: Five miles northeast of Beeville, Bee County, and adjacent to the G. H. & S. A. Railroad.
Latitude: 28 degrees north.
Longitude: 97 degrees west.
Elevation: 240 feet above sea level.
Area: 151.5 acres.
Average rainfall for 25 years: 29.49 inches annually.
Rainfall for 1920: 22.31 inches.

Cotton variety tests have been conducted on this Substation for 13 years. In 1920, using 10 varieties, Mebane, Belton, Kasch, Lone Star,

and Acala were the highest yielders in the order named. In length of staple, Snowflake, Durango, and Acala ranked highest, with $1\frac{1}{4}$, $1^{3}/_{16}$, and $1\frac{1}{8}$ inches, respectively. Over a period of years, Mebane has made the highest yield, with Durango second.

The cottonseed source of seed test has run three years. Home-grown seed has yielded better on the average than that brought from eight other substations, and also produced a longer staple.

The cotton time of thinning test has run for three years. The highest average yield is produced on the plats that were thinned early.

In the cotton seeding rate test, in three-foot rows, and hills from 3 inches to 36 inches apart, the best results are obtained in hills 12 inches apart over a period of years.

In the clean culture vs. weeds test, the best results are obtained when the crop is kept clean. There appears to be little or no value in a dust mulch.

In the corn variety test, using 11 varieties, Surcropper, Virginia White Dent, Giant White Red Cob, and Thomas gave the highest yield. Thomas is the highest and most consistent yielder over a period of years. This variety is being improved in ear-to-row tests.

In the corn seeding rate test, the best yields were obtained in three-foot rows with one stalk in the hill 30 to 36 inches apart. This conforms to previous results.

In the clean culture vs. weeds test with corn, previous results were again confirmed. The best yields were obtained when the crop was kept clean.

Results of the test to determine the best time to plant cowpeas as an intertillage crop in corn, indicate that it is not desirable to plant cowpeas in corn before the corn is 12 inches high.

The results of nine years experiments with small grains indicate quite conclusively that none of those tested will yield a dependable grain crop in this section. Oats make a valuable winter pasture and hay crop.

The Chinese Red cowpea stands out as the most dependable variety for the production of seed. The upright habit of growth of this variety makes it also a desirable hay crop, though the yield of hay is not quite up to Groit.

In the peanut seeding rate test, using the Spanish variety, the best yields were obtained with the plants 6 inches apart in the row, using 36-inch rows. The results of previous years indicate that close spacing is preferable.

Grain sorghums have been grown here at intervals for 15 years, but no variety has proved as dependable as corn as a grain crop. The best results are obtained with broom corn on an average when the hills are 12 to 18 inches apart. Sudan is a valuable hay crop, but the seed often fails to fill out.

Citrus fruit experiments have been conducted at this Substation for 24 years. The present orchard, consisting of four acres, is 14 years old, and contains 393 trees. There are 27 varieties of oranges, 7 of grapefruit, 2 of kumquats, 2 of lemons, and 1 lime. The results indicate that Satsumas, grapefruit, kumquats, and a few varieties of oranges can be successfully grown here commercially. Irrigation, heating, and proper cultural methods are essential factors of success.

Substation No. 2, Troup:

Location: One mile northeast of Troup, Smith County.
Latitude: 32 degrees north.
Longitude: 95 degrees west.
Elevation: 467 feet above sea level.
Area: 150 acres.
Average rainfall for 16 years: 42.96 inches annually.
Rainfall for 1920: 48.58 inches.
Number of experiments in 1920: 653.

Of the 11 varieties of cotton tested in 1920 the six highest yielders of lint cotton were Acala, Belton, Rowden, Kasch, Durango, and Mebane ranking in the order named. Durango produced a staple $1^3/_{16}$ inches in length, which was the longest of the six varieties named, and Mebane produced a one-inch staple, which was the shortest. In number of bolls required to make a pound of seed cotton these six varieties ranked: Mebane, 50; Belton, 51; Kasch, 54; Rowden, 56; Acala, 59, and Durango, 69.

The variety test with cotton has been run continuously for eight years, the number of varieties tested each year varying from 11 to 59. The small-boll, short-staple varieties have generally made the higher yields of lint to the acre. Among these varieties are Cook, Half and Half, and Peterkin. In communities where the length of staple is not considered a factor in the value of lint, these varieties may prove the more profitable. The varieties producing a staple one inch or more in length which have made consistent high yields for eight years are: Mebane, Lone Star, and Rowden. Durango and Snowflake have been the best long-staple varieties. Experiments here, however, show that none of the long-staple varieties is a consistent high yielder and these varieties are not, therefore, dependable.

In the corn variety test the highest yielding varieties were Chisholm, Ferguson Yellow Dent, Hastings Prolific, St. Charles White, and Davis Prolific, ranking in yield in the order named. Of the varieties that have been grown five or more years, Munson, Ferguson Yellow Dent, Davis Prolific, Surcropper, and Hastings Prolific led in average yield in the order mentioned.

In the tomato variety test, using 27 varieties, Matchless, Paragon, Earliana, Norton, and Beauty made the highest yields, in the order named. Coreless and Buckeye State showed the highest per cent. of fruits infected with blossom end rot.

In the fertilizer test with tomatoes, plats receiving 500 pounds of acid phosphate to the acre made the highest yield; the plat receiving 20 tons of manure to the acre ranked second and the cotton seedmeal plat, 500 pounds to the acre, ranked third in yield. Sulphate of potash, when used alone, at the rate of 100 pounds to the acre, made no increase in yield. Highly fertilized plats showed a higher per cent. of blossom end rot than the unfertilized plats, but the increase in yield more than compensated for the loss from the disease.

In the fruit tree introduction test, consisting of over 300 varieties, only one plum variety, the Methley, produced fruit this year. This is a very promising Japanese hybrid, which has borne two years.

In the test of northern-grown certified seed of Irish potatoes three

lots of certified seed from Wisconsin ranked 1, 2, and 3 in yield, and three lots from Nebraska ranked 4, 5, and 6. These lots produced 220, 206, 195, 190, 189, and 183 bushels per acre, respectively. The seed of unknown origin, purchased on the local market for comparison, yielded 128 bushels per acre. The seed from the non-irrigated district of Nebraska produced uniformly higher yields than the seed grown under irrigation.

Bulletin No. 277, giving the results of fertilizer experiments with seed potatoes, was issued during the year.

Substation No. 3, Angleton:

Location: Three and six-tenths miles northeast of Angleton, Brazoria County, and adjacent to the St. L., B. & M. Railroad.

Latitude: 29 degrees north.

Longitude: 95 degrees west.

Elevation: 25 feet above sea level.

Area: 157 acres.

Average rainfall for seven years: 45.57 inches annually.

Rainfall for 1920: 49.28 inches.

Number of experiments in 1920: 673.

In the cotton variety test, using 10 varieties, Acala, Mebane, Kasch, and Rowden were the high yielders in the order named. In addition to its record as the high yielder, Acala produced a staple $1\frac{1}{8}$ inches in length. This test has run since 1913, with some interruptions due to loss of crops. Bulletin No. 274 discusses in detail the behavior of the varieties tested throughout the period. This bulletin was published in February, 1921, and the supply for distribution was practically exhausted in August, 1921, owing to the heavy demand for this information. The conclusions in this bulletin, based upon the average results throughout the history of this test, are, therefore, quoted here: "Mebane has made the highest average yield to the acre. Furthermore, it has been the most profitable variety. Kasch, Lone Star, and Acala, named in order of yield, are the other three varieties well adapted to the conditions in this part of Texas. Lone Star, on account of its staple, has been slightly more profitable than Kasch. Snowflake has been the best-yielding and most profitable variety of long-staple cotton grown at Substation No. 3. Mebane, Lone Star, and Kasch have large bolls, while Acala and Snowflake have smaller bolls. As an average of the four years, the following number of well-opened bolls were required to make a pound of seed cotton of the different varieties: Mebane, 62; Kasch, 60; Lone Star, 59; Acala, 70, and Snowflake, 78 bolls."

In the cottonseed source test, the home-grown seed yielded better than that brought from the plats at several other substations.

The cotton thinning experiment has run four years. Results of the four-year average show for rate of thinning in three-foot rows as follows: 3 in., 240 pounds lint; 6 in., 285 pounds lint; 9 in., 274 pounds lint; 12 in., 267 pounds lint; 15 in., 239 pounds lint; 18 in., 255 pounds lint, and decreasing yields as the spacing was widened up to 36 inches. The date of thinning test in which cotton planted at different distances in the row has been thinned at two different stages of growth gave, this year, 332 pounds of lint to the acre for the early thinning, and 246

pounds of lint to the acre for the late thinning. As a result of four years' testing, 36-inch rows have outyielded wider rows carrying the same number of plants per acre.

In the corn variety test, using 11 varieties, Fentress Strawberry, Virginia White Dent, and Ferguson Yellow Dent led in yield in the order mentioned. Tuxpan, a reliable yielder when corn production has been more or less irregular, is being selected and improved. Seed corn from this car-to-row test is being distributed. Bulletin No. 276, discussing this work, was published and 600 copies are yet available.

In the corn seeding rate test, previous results were again confirmed this year and the best yields were secured in three-foot rows with one stalk in the hill 18 inches and 24 inches apart in the order mentioned. A seven-year average shows the same results. Plantings were made as close as 14 inches in the row and as wide as 72 inches. The same number of stalks per acre in three-foot rows yielded 26 per cent. more corn than that in six-foot rows. Results so far indicate that it is not desirable to plant cowpeas in corn until after the corn is 36 inches high, and the high yield of corn in this test resulted in corn that was five feet high when the peas were planted. This indicated that cowpeas should be planted at the last cultivation of the crop.

Five years' experiments with small grains point quite conclusively that none of them will yield a dependable crop in this region, although oats and rye will yield a hay crop if properly harvested.

Cowpea variety tests covering the last five years show that the New Era has produced the largest yield of seed and the Groit has produced the largest yield of hay. The highest yield of seed has been produced by planting nine pounds of seed to the acre as compared to four other rates, while the highest yield of forage has been secured by planting 15 pounds of seed to the acre. The highest yields of seed have been produced by planting about the middle of April as compared to plantings extending from the first of April to the middle of July, while the highest yield of forage has been secured by plantings between the middle of May and the middle of June.

Peanut variety tests have been conducted on this substation for six years in order to find the variety best adapted to the humid conditions and low altitude of this region. In various years the yields have varied from three bushels to as high as 201 bushels to the acre, while the forage yield has varied from 400 pounds to 7400 pounds to the acre. The maximum yield of nuts mentioned were made by the Spanish peanut, but for the six-year period the Virginia Bunch has slightly outyielded the Spanish in nuts and the Improved Valencia has produced the highest yield of forage. The averages as a result of six years' experiments are: Virginia Bunch, 69 bushels of nuts, and 4288 pounds of forage; Spanish, 67 bushels of nuts, and 3592 pounds of forage; Improved Valencia, 48 bushels of nuts, and 4344 pounds of forage.

The highest average yield of Spanish peanuts, both nuts and vines, occurred in 36-inch rows with plants six inches apart. This confirms records secured in 1915 and in 1918. In all cases the yield decreases as the plants are spaced wider apart.

Two years of experimenting with grain sorghums indicate so far that none of them will make seed here profitably.

Sudan Grass yielded as high as 10,142 pounds of cured hay to the acre and in and eight-year average is found to produce best in 18-inch rows.

Japanese Sugar Cane in a six-year average produced 56,768 pounds of green forage to the acre when three lines of canes were planted in the drill. Two lines of canes and one line produced 56,751 pounds and 50,136 pounds, respectively. This crop is easily kept for feed by cutting and piling and may be fed from the ricks through the winter. The stalks furnish a succulent feed that is nutritious and the fodder is very good roughness.

Rhodes grass planted in 1915 and yielding 5775 pounds of cured hay to the acre that year, has gradually decreased in yield and this year yielded only 3234 pounds, averaging for the six years 3741 pounds per acre.

In cooperation with the Office of Forage Crops Investigations, United States Department of Agriculture, a number of forage grasses from other countries are being tested at this station. This year 37 lots are under test. Of these, Napier grass, Para grass, Carib grass, Giant Bermuda, and *Andropogon annulatus* are especially recommended and are being widely distributed to farmers. The demand is in excess of the supply.

Substation No. 4, Beaumont:

Location: Six miles west of Beaumont, on the S. P. and B., S. L. & W. Railroads.

Latitude: 30 degrees north.

Longitude: 94 degrees west.

Elevation: 26.5 feet above sea level.

Area: 100 acres.

Average rainfall for 28 years: 49.92 inches annually.

Rainfall for 1920: 57.77 inches.

Number of experiments and tests in 1920: 1739.

Land where rice was seriously damaged by disease in 1919 showed no recurrence of the disease when planted to rice again this year.

The rice variety test included, this year, 237 lots, a large number of which are pure-line pedigreed varieties developed on this substation. There were included, also, the leading commercial varieties and a number of varieties newly introduced from other rice growing countries. Three different lots in this test produced grain which tested 53 pounds and two lots produced grain which tested 52 pounds per bushel. The highest yielders in their order are as follows: 0-28, Pure-line Honduras; 2203-4 Louisiana Pearl Pure-line; 1593 Bruinmissie; 1519 Blue Rose; 1611-8 Pure-line Honduras; 2198-2 Pure-line Early Prolific; 2204-11 Pure-line Honduras; and 4298 Blue Rose.

There were handled in the rice nursery this year 162 pure lines. All of this material is hand-transplanted and grown as pure-line pedigree material. Several lots of this which have proved to be superior to standard material are moved into the variety test from year to year, while others are discarded. A pure-line selection from Honduras made the highest yields in this part of the rice experiments this year.

In the seed bed preparation experiment, although the crop was some-

what damaged by army worms, the following results were secured; 5-inch plowing, 88 bushels to the acre; 8-inch plowing, 47 bushels to the acre.

In the rate of seeding experiment the following results were secured; 120 pounds of seed used, produced 74 bushels rice per acre; 80 pounds seed used, produced 60 bushels; 100 pounds seed used, produced 42 bushels.

In the rice fertilizer test, the best yield this year was secured from the use of 150 pounds of ammonium sulphate per acre, which produced at the rate of 3360 pounds of rice to the acre. The second highest yield was produced by the use of 200 pounds of ammonium sulphate, and 300 pounds of acid phosphate per acre which produced 2833 pounds of rice to the acre. Ammonium sulphate, 100 pounds, and acid phosphate, 150 pounds, gave 2662 pounds of rice; and acid phosphate, 150 pounds, gave 2299 pounds of rice. The check plat, on which no fertilizer was used, produced 1452 pounds of rice. In a period of five years ammonium sulphate, applied at the rate of 100 pounds per acre the first three years, and 150 pounds for the last two, has made the highest average yield, 2286 pounds of rice per acre. The next highest yield was with the ammonium sulphate, 200 pounds, and acid phosphate, 300 pounds, averaging 2172 pounds of rice per acre. The lowest yield for the five-year period came from the plat receiving 12,000 pounds of manure per acre each year, which gave an average yield of 1494 pounds of rice per acre. The check plat, which received no fertilizer, averaged 1511 pounds of rice per acre. It is interesting to note that the plat receiving ammonium sulphate, 100 pounds, and acid phosphate, 150 pounds, yielded an average of 2128 pounds of rice per acre; the plat receiving ammonium sulphate, 50 pounds, and acid phosphate, 75 pounds, made an average of 2026 pounds of rice per acre; the plat receiving acid phosphate 150 pounds averaged 2002 pounds of rice per acre; the plat receiving cottonseed meal 300 pounds yielded 2001 pounds of rice per acre; the plat receiving acid phosphate 150 pounds and cottonseed meal 300 pounds averaged 1857 pounds of rice per acre, and the plat receiving acid phosphate 150 pounds and manure 12,000 pounds averaged 1769 pounds of rice per acre. The fertilizers have not been applied at a uniform date through the various years of this experiment. When they were applied at planting time in the first years of the experiment weed growth was encouraged to the extent that the crop was reduced, especially in the succeeding years of the experiment. This accounts for the poor showing of the manured plats. In the later years of the experiment, the fertilizers, excepting manure, were applied to the growing crop before booting and the weeds have not been so damaging to the yields.

Grain sorghums have not resisted the midge, regardless of the date of planting.

In the corn variety test, using 23 varieties, Tuxpan, Hastings Prolific, and Chisholm, were the high yielders in the order named. Tuxpan yielded 47 bushels to the acre this year.

Black Medic, a winter- and spring-growing clover, valuable for pasture, was planted in five different locations on the farm in January. Four of these lots grew well and reached a height of six inches.

Three varieties of hemp were tested in co-operation with the United States Department of Agriculture this season. A satisfactory growth of plant and very good yields of seed were obtained.

Substation No. 5, Temple:

Location: Four and one-half miles southwest of Temple, and four miles northeast of Belton, and adjoining the Temple-Belton interurban and highway.

Latitude: 31 degrees north.

Longitude: 97 degrees west.

Elevation: 740 feet above sea level.

Area: 96 acres.

Average rainfall for eight years: 37.63 inches annually.

Rainfall for 1920: 44.73 inches.

The chief activities of this substation have to do with experiments with general farm crops, specializing in the study of the problems of cotton and cotton diseases. During the year there were conducted 1066 tests, under 47 different divisions of effort. During the year, 1996 persons visited the substation. Of these, 941 came to see some specific thing on the farm, and 1055 attended meetings at the substation. In the cotton variety test, six out of the eight varieties used yielded in excess of one bale of lint to the acre. In yield of lint cotton to the acre, the three highest varieties were Mebane, Kasch, and Belton, respectively, though the average for the past five years would place Kasch, Mebane, and Rowden, respectively, as the three high-yielding varieties. On a money value per acre basis, the three highest varieties for 1920 were Snowflake, Belton, and Acala, respectively.

The cotton rate-of-planting test, as an average for the past six years, has produced the highest yield of lint cotton where the plants were thinned to a distance of 12 inches apart in the row in three-foot rows.

Average results covering five years' work in a source-of-cotton seed test, showed that home-grown seed of a given variety would produce higher yields than seed of the same variety secured from widely separated points in the State.

Corn variety tests, using the leading Texas strains, indicated that Gorham's Yellow Dent, Surcropper, and Ferguson's Yellow Dent, respectively, to be the highest yielders for the past three years. Width-of-row tests with corn, conducted since 1913, showed that the 36-inch row is preferable.

Kanred wheat produced slightly higher yields during the past three years than five other leading varieties.

For the past two years, Iron and Brabham cowpeas have been the highest yielders of hay out of eight varieties. Guar, a root-rot resisting legume, yielded cured forage at the rate of 4500 pounds to the acre in 1920. While coarse, this forage is relished by livestock, and its analysis is comparable with that of alfalfa hay.

Of the clovers tested, the white sweet and the black medic made very good showing.

In the test of grain sorghums, feterita was the highest yielder. Spur feterita, a strain developed at Substation No. 7, Spur, produced 1.28 bushels to the acre more than common feterita for the past two years.

Sudan grass planted for hay produced the highest yields from 36-inch rows from a seeding rate of 8 pounds to the acre. When broadcasted, the highest yields of hay were secured from a seeding rate of 30 pounds to the acre, but the broadcasted crop yielded only 1463 pounds as against 2646 pounds to the acre from the row planting.

In a four-year rotation using cotton, legumes, corn and wheat, a five-year record gave an increase of 1.6 bushels of wheat to the acre over non-rotated wheat; a six-year record with corn gave 13.7 bushels to the acre more than non-rotated corn; and a seven-year record with cotton gave 153 pounds of lint to the acre more than non-rotated cotton. Three-year rotations showed increased yields in favor of rotation as against non-rotation, but were not as effective as the four-year rotations.

Undoubtedly this remarkable increase in the yield of cotton in the rotation is partly due to the effectiveness of rotation in controlling root rot. Root rot infestation under the rotation was only 4.84 per cent., while the non-rotated plats showed 42.97 per cent. infestation. In the three-year rotations the root rot infestation in cotton was 7.2 and 8.2 per cent., respectively, on the rotated plats, and 30.37 per cent. infestation in each case on the non-rotated plats.

The field work on the cotton root rot project was done on this substation, and 149 of these experiments were made here this year.

Twenty-five hundred fruit, shade, and ornamental trees were distributed to rural schools and individuals, from the surplus of trees grown for experiments and tests.

Substation No. 6, Denton:

Location: Five and one-half miles northwest of Denton, Denton County, on the Denton-Krum pike.

Latitude: 33 degrees north.

Longitude: 97 degrees west.

Elevation: 600 feet above sea level.

Area: 203 acres.

Average rainfall for eight years: 38.35 inches annually.

Rainfall for 1920: 49.93 inches.

Number of experiments in 1920: 2674, of which 2167 were with small grains.

Due to unfavorable weather conditions, the cotton experiments were practically failures.

The corn variety test included 12 of the outstanding varieties heretofore tested. Fentress Strawberry and Surcropper were the high yielders. Fentress Strawberry is the high yielder in a three-year average, but the general planting on this substation will continue to be Surcropper, because of its reliability.

In the winter wheat variety test conducted here since 1912, Kanred, a hard winter wheat, ranked first and Mediterranean ranked second. These two varieties have about the same average yield for the past four years. In a three-year average early grown wheat planted at 75 pounds per acre has outyielded other rates of planting ranging from 30 to 105 pounds to the acre. Late-sown wheat, however, has shown the largest net crop after seed is deducted, on the thinnest seedings. Irrespective of date of planting, a four-year average shows that 90 pounds of seed

to the acre has given, slightly, the greatest net crop after deducting the amount of seed used.

In the winter oats variety test, of 18 varieties grown, Culberson and Hutcheson were the high yielders this year, doubtless due to their resistance to winter-killing. In a five-year average these varieties were second and third and a Red Rust Proof Oat, T. S. No. 1415, was first with a yield of 53.9 bushels per acre against 47.3 for Culberson and 44.8 for Hutcheson. It is interesting to note that T. S. No. 1415 has been the high yielder at the Main Station at College Station for several years.

In an experiment using Red Rust Proof Oats sown November 20th and February 9th, using 5, 6, 7, 8, 9, and 10 pecks of seed to the acre, the 8-peck rate made the highest yield for the fall planting, and the 10-peck rate made the highest yield for the spring planting. The spring planting averaged 41 bushels and the fall planting averaged 29 bushels to the acre. A three-year average in this project favors the 9-peck rate for the early seeding and a 10-peck rate for the late seeding, and the yield is 31.1 bushels for late seeding and 44.9 bushels for early seeding.

Three years' experimenting with winter barley indicates that Tennessee Winter is the best variety for North Texas and that it should be planted in October at the rate of from 6 to 8 pecks to the acre.

Many excellent, high-yielding, stiff-stemmed, rust-resisting strains of wheat and oats are on hand for increasing and further testing from the 1040 head-row wheat plats and the 520 head-row oat plats grown this year.

In rotation of grains with Biennial White Sweet Clover, very large increases were noted in the grain-producing power of the soil following Sweet Clover. The Sweet Clover has shown high value for hay and for pasture in addition to seed production. The best results were secured by seeding with 9 to 10 pounds of good seed to the acre. The mechanical condition of the soil was greatly improved by growing Sweet Clover.

Black Medic, a winter- and spring-growing clover, suited for pasture, has produced well on this station.

Four years' results are available on a three-year rotation of corn, winter wheat, and cotton in which the corn is manured with 10 tons of barnyard manure. Rotated cotton yielded 447 pounds seed cotton against 356 pounds for the non-rotated cotton.

In a rotation of corn, winter oats followed by cowpeas for green manure, cowpeas for hay, and winter wheat followed by cowpeas for green manure when possible, the wheat yielded 19.106 bushels per acre and on the non-rotated check plat, 9.38 bushels per acre. In a similar rotation, except that the cowpeas were grown for seed, the rotated wheat made 18.55 bushels to the acre, and the non-rotated made 9.33 bushels to the acre.

In a rotation of cotton, cowpeas for seed, corn, winter wheat and cowpeas grown, when possible, after winter wheat as a catch crop, the rotated wheat yielded 13.64 bushels to the acre and the non-rotated wheat yielded 9.33 bushels to the acre.

Substation No. 7, Spur:

Location: One mile west of Spur, in Dickens County.
Latitude: 33 degrees north.
Longitude: 100 degrees west.
Elevation: 2274 feet above sea level.
Area: Owned, 160 acres; leased, 246 acres; total, 406 acres.
Average rainfall for 10 years: 24.63 inches annually.
Rainfall for 1920: 28.0 inches.
Number of experiments in 1920: 786.

The cotton tests, including the variety test, source-of-seed test, spacing or thinning test, date-of-planting test, and cultivation test, were practically destroyed this year by a hail covering a narrow belt of the country in June. Heavy rains in the late summer, followed by worms, practically ruined all of the cotton which recovered from the hail.

In experiments made in caring for hail-damaged cotton, it was found that cotton plants with 2 to 4 fruiting branches and with green buds in the axils of the leaves, when cultivated as soon as possible after the hail, could be partially saved. When not cultivated after the hail, all the plants died, but of those plants cultivated immediately, 22 per cent. survived and produced fruit. Young cotton plants not yet branched all died whether cultivated or not. Cotton planted June 21st, immediately after hail, failed to mature fruit. Early cotton selections made in 1919 gave sufficient promise this year in two cases to justify further trial.

In the cowpea variety test grown for seed, 13 varieties were used. The highest yielders this year were: New Revenue, Chinese Red, and New Era, in the order named. In averages extending over a period of years, the Chinese Red is much the heavier seed producer and the New Era ranks as the second best seed producer. The New Era is a very superior forage variety, and is advised for general use.

The comparison of corn and grain sorghum yields, begun last year, to secure definite figures on the relative production of these grains, shows the following average results for the two years: Spur feterita, 58 bushels to the acre and Surcropper corn, 16 bushels to the acre. These were considered very good corn yields, as are the grain-sorghum yields.

Eleven of the best varieties of grain sorghums were planted in variety tests at four different dates, May 15th, May 29th, June 21st, and July 10th. The early planting was somewhat injured by hail. The kafir, or kafir-like varieties outyielded other varieties in the early planting. In the plantings made May 29th the high yields were made by the milo varieties. In the plantings made June 21st, feterita and milo were the high yielders. In the plantings made July 10th, feterita outyielded all other varieties. These yields have a direct relation to the time required for the maturity of these crops. Dwarf milo, T. S. No. 670, made the best average yield, 45.61 bushels to the acre, and Spur feterita made the second best yield, 43.40 bushels per acre. A six-year average in the variety tests with grain sorghum shows feterita leading with a yield of 39.18 bushels, milo second with 29.7 bushels, and kafir third with 19.38 bushels to the acre.

In the variety test of 9 varieties of forage sorghum, Honey Drip made the highest yield, 12,562 pounds cured forage to the acre. Orange was second with 9119 pounds, and Sumac was third with 8954 pounds.

In an average for the last eight years, Sumac has produced 6.037 tons of forage per acre and Orange is second with 5.116 tons. Sumac is, therefore, classed as the most suitable variety for this region.

Experiments in which milo was planted in three-foot rows and thinned to twelve different rates in the row, varying from 3 to 36 inches, the 15-inch spacing made 71 bushels, the 12-inch spacing 69 bushels, the 9-inch spacing 67 bushels, and the 18-inch spacing made 63 bushels per acre, with yields decreasing at the other rates. In an average of five years, the 12-inch spacing has led in yield with 54.76 bushels per acre, followed by 15-inch spacing with 52 bushels per acre.

Alfalfa is grown on the Station as an upland non-irrigated crop. In a rate-of-planting test, planted in April, 1919, the 21-pound rate of seeding produced 4125 pounds of hay to the acre this year. The yields decreased through the eleven rates of planting to the lowest 3597 pounds of hay to the acre made at the 3-pound rate of seeding. In a rate-test planting made May, 1916, the heaviest yield this year was 5280 pounds of cured hay to the acre, made by the 6-pound rate of seeding. During the four years, in which crops have been secured in this experiment, the 4-pound rate of seeding leads slightly with an average of 1.675 tons to the acre, though the plantings at 2, 4, 6, 8, and 10 pounds of seed to the acre are almost as good. In a rate-of-planting test with Grimm alfalfa planted in May, 1916, at five different rates, the best yield this year, and for the entire period, was from the 4-pound rate of planting, though the other rates varying from 2 to 10 pounds gave only slightly lower yields. In the four-year average Grimm, at the 4-pound rate of seeding, yielded 1.284 tons of cured hay to the acre. Alfalfa planted in 36-inch rows has made 1.251 tons to the acre, against 1.611 tons average for drill planting. In the 17,000 individual alfalfa plants planted in 1919 for observation and selection, 7 especially promising plants were secured this year.

Experiments with 16 methods of cultivation of feterita, covering two years, have been conducted. An abundance of cultivation given throughout the life of the plant has shown the best results, though the exact time and the depth of the cultivation seems to be of relatively little importance. The prevention of all growth of weeds and grasses appears to be the major benefit received from cultivation.

Plowing has given the highest yields as a preparation for planting sorghum for forage. The lowest yields were from shallow work with a lister or with a disk in the spring. Shallow fall preparation also gave low yields. The largest yields of milo were from ground worked three inches deep in October. January preparation has given the poorest yield of milo, and plowing is better than listing or disking.

In the rotation of grain sorghum with cotton, feterita after feterita, continuously manured, gave, this year, 43 bushels per acre and for a period of six years has averaged 26 bushels; feterita after feterita, continuously, gave, this year, 38 bushels per acre and for six years 20 bushels; feterita after cotton, gave, this year, 28 bushels per acre, and for six years 20 bushels; feterita after cotton, manured, gave, this year, 25 bushels and for six years 14 bushels; cotton after cotton, continuously manured, gave, this year, no yield,* due to hail, and for six years an average of 128.75 pounds lint cotton per acre;† cotton after cotton,

continuously, gave, this year, no yield,* and for six years 120 pounds lint cotton per acre;† cotton after feterita, gave, this year, no yield* and for six years 144.3 pounds lint cotton per acre;† and cotton after feterita, manured, gave, this year, no yield* and for six years 105.72 pounds lint cotton per acre.†

Practically no fruit crop was raised in the orchard this year because of late frosts. There are 220 trees in variety test in the orchard.

Of nine varieties of forest and shade trees planted in 1918 in amounts ranging from 200 to 1000 each, the Black Locust, American Elm, Green Ash, Texas Umbrella, Bois d'Arc, and the Salt Cedar have all made good showings.

Lamb feeding, steer feeding, and investigations with sheep were carried on during the year, and are reported upon in detail under the Division of Animal Industry. Barns, feeding pens, corrals, and pasture or grazing lands are maintained for the animal industry investigations, and flocks of sheep are kept. The animal industry work at this substation represents quite a large part of the activities. The Station holds a lease of 246.35 acres of grazing land adjoining Substation No. 7, which is utilized in connection with the animal industry work.

Substation No. 8, Lubbock:

Location: Three miles east of Lubbock, Lubbock County, on the Lubbock-Crosbyton highway.

Latitude: 33 degrees north.

Longitude: 101 degrees west.

Elevation: 3200 feet above sea level.

Area: 160 acres.

Average rainfall for 10 years: 20.42 inches annually.

Rainfall for 1920: 18.16 inches.

Number of experiments in 1920: 2060.

In the cotton variety test, using 11 varieties, the highest yielders in pounds of lint per acre were: Burnett, 582; Mebane, 477; T. S. No. 4119, Lone Star, 398; T. S. No. 3150, Lone Star, 315; Belton, 287. Of the longer staple varieties, the high yielders were: Durango, 259; Acala, 230; Snowflake, 189.

The Burnett, which yielded best this year and has made consistently good yields here in previous years, is not yet satisfactory for general use because of its short staple, small boll, and lack of storm-resistance. Of the shorter-staple varieties, Mebane is advised. Of the longer-staple varieties, Durango is superior.

In the source-of-planting seed test with cotton, as an average of three years, the highest yields of seed cotton were obtained from the seed grown at Spur, Lubbock, Nacogdoches, and Beeville in the order named. The results seem to indicate that home-grown seed or seed from points having similar climatic conditions to those prevailing at this point give the best yields.

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*Hail destroyed the cotton crop on June 21st, excepting a few plants not in this test.

†These averages are made by using the six years through which the experiments have run. The crop was destroyed in 1916 and in 1920 by hail and in 1918, due to drouth, there was almost a complete failure.

The variety test of corn, including only a few varieties, has been conducted since 1917. This year Dwarf Mexican June made the highest yield, 36 bushels to the acre. In an average of the four years, including two wet years and two dry years during which this test has run, Surcropper leads with 23.9 bushels, Chisholm is next with 22.43 bushels, and Mexican June is next with 22.3 bushels. A Mexican June corn has averaged 25.37 bushels per acre for nine years, and a milo has averaged 29.79 bushels for the same period. In the systematic comparison of corn and grain sorghum for the past two years, milo leads corn by 16.21 bushels. The best date for planting corn for the two years this point has been investigated, is April 15th.

Turkey Red wheat produced this year 13.61 bushels per acre, and an average for six years of 6.75 bushels per acre.

The cowpea variety test included 12 varieties. The three highest yielders this year were: Iron, 9.92; Chinese Red, 8.61; and Chinese Yellow, 8.25 bushels per acre. In a seven-year average, New Era has produced the highest seed yield, 12.87 bushels to the acre, Chinese Whippoorwill is second with 12.69 bushels to the acre, and all varieties yield seed well in this region. Iron-Blackeye Hybrid, and Jap Blackeye were, respectively, the best forage yielders this year.

In a test of edible dry bean production, Extra Early Lima with 17.87 bushels, Tepary Bean with 12.60 bushels, and Queen Pea with 7.51 bushels per acre were the best yielders. In a six-year average, Tepary Bean yielded 14.5 bushels and Extra Early Lima has averaged 9.38 bushels per acre. For a period of four years, the Cream Pea has averaged 10 bushels to the acre.

Spanish peanuts in three-foot rows with six-inch spacing, yielded 60.6 bushels; with 9-inch spacing, 58.1 bushels per acre this year. The yields decreased as the spacing was widened and 18-inch spacing gave only 41.71 bushels.

Alfalfa in three-foot rows yielded 1.71 tons of hay per acre this year. Drilled alfalfa (8-inch spacing) made 1.59 tons of hay to the acre. These are upland dry-land fields.

Five acres of Biennial White Sweet Clover, seeded the previous year, was profitably pastured in the spring and then yielded 1.08 tons of good hay to the acre in the fall.

The grain sorghum variety test included 43 varieties this year. Of the early commercial types the best yielders were: Dwarf Yellow Milo, 29.21 bushels; Pure Line, 153; Kafir, 53.03 bushels; and Leafy Feterita, 37.80 bushels per acre. The late-maturing, long-season varieties were much favored by weather conditions and the three high yielders were: T. S. No. 1653 Shallu, 66.29 bushels; T. S. No. 2450 Schrock Kafir, 64.81 bushels; T. S. No. 3682 Kafir, 57.69 bushels per acre. But, in a nine-year-average, T. S. No. 672 Standard Milo heads with 29.79 bushels to the acre, and in an eight-year-average with 12 varieties T. S. No. 45, Pink Kafir, leads with 33.78 bushels per acre. A five-year-average with 27 varieties gives Shallu 44.55 bushels, Darso 33.05 bushels, and T. S. No. 672, 29.94 bushels per acre.

In the kafir inbreeding and head-type study started in 1916, the selection with short seed branches gave the highest average yield, 71.8

bushels to the acre; while the selection for few seed branches made the lowest average yield, 55.2 bushels to the acre.

Observations of the inheritance of an abnormal spur at the base of the kafir head gave no evidence that this character is transmitted to the progeny.

Three separate acres were seeded, each to a pure line of kafir from the breeding plats. These were increased and Pure-line No. 153 will be kept pure for distribution next season.

The study of the natural amount of cross pollination in grain sorghums begun in 1918, was continued and 36 head-rows comprising 18,804 plants were produced for record. The greatest amount of cross fertilization was 2.98 per cent., the least was .33 per cent., and the average was 1.669 per cent.

Hybrids between Blackhul Kafir and Red Kafir showed the Red Kafir type and shape of head to be dominant, while the color of the seed was intermediate.

Bulletin No. 279 entitled "Type and Variability in Kafir," was published.

In a seeding rate test with Dwarf Blackhul Kafir carried through five years in three-foot rows, the best yields are from the thickest seeding. There were 12 rates varying from 3 to 36 inches. The yields decreased consistently from 3 to 27 inches and thereafter increased slightly. In a similar five-year test with Dwarf Yellow Milo, the highest yields are from the 27-inch spacing and decrease in each direction.

A study of the shrinkage of grain sorghum heads showed 5 to 8 per cent. shrinkage in well matured heads beginning to turn yellow and in proper condition for heading. In immature heads, a shrinkage as high as 25 to 35 per cent. was found.

Duplicate plats of 21 varieties of sweet sorghum were grown for a yield test in both dry and green forage. The three highest yielders of green forage were: Honey, 15.15 tons; Gooseneck, 13.99, and Old Mexican, 13.83 tons per acre. A five-year average of 20 varieties shows Honey, Planters' Friend, and Japanese Seeded leading in green-forage production in the order named. The highest yielders of dry forage this year were: Honey, 8.93 tons; Old Mexican, 8.57 tons; and Gooseneck, 8.16 tons to the acre, and for a five-year period Honey, Old Mexican, and Orange in the order named.

In a spacing test with Sumac Sorgo, conducted for four years, comparing plantings 3, 6, 9, 12, 15, and 18 inches apart in three-foot rows, the highest yields have resulted from the thickest seeding and the yields decrease rather regularly as the spacing is widened.

Varying the conditions, and dates of harvesting had a material effect on the color of the seed of a Creamhul strain of Sudan grass. Rain between cutting and threshing darkened the seed. A five-year test shows that ten pounds of seed to the acre in 18-inch rows made the highest yields of hay, and 20 pounds of seed to the acre in 18-inch rows made the second highest yields. In a three-year test, ten pounds of Sudan grass seed to the acre in three-foot rows made the highest yield of seed. The second highest yield in seed was in 18-inch rows at 20 pounds to the acre. The lowest seed yields were from broadcast plantings. In

broadcast plantings for hay, Sudan seeded at ten pounds per acre made the highest yields in a four-year test.

A three-year study of cotton seedbed preparation showed the best yields from plowing followed by listing. The lowest yields were made on lands that were disked. Thorough intertillage made the best yields.

In the rotation of grain sorghum with cotton, feterita after feterita continuously manured, gave, this year, 69 bushels per acre and for a period of six years has averaged 32 bushels; feterita after feterita, continuously, gave, this year, 56 bushels per acre, and for seven years 27 bushels; feterita after cotton, gave, this year, 62 bushels per acre, and for seven years 35 bushels; feterita after cotton, manured, gave, this year, 66 bushels, and for seven years 30 bushels per acre; cotton after cotton, continuously manured, gave, this year, 223 pounds lint cotton per acre, and for seven years 285 pounds; cotton after cotton, continuously, gave, this year, 223 pounds lint cotton per acre, and for seven years 253 pounds; cotton after feterita, gave, this year, 279 pounds lint cotton per acre, and for seven years 265 pounds, and cotton after feterita manured, gave, this year, 250 pounds lint cotton per acre, and for seven years 220 pounds.

Of 13 varieties of watermelons grown, New Tom Watson, Tom Watson, and Alabama Sweet proved best for market planting, and Halbert Honey, Golden Heart, and Georgia Sweet were best for home use.

Of 15 varieties of cantaloupes tested, the best in point of yield and quality, were: Gold Winner, Netted Rock King, Netted Nugget, and Salamon Tint Pollock.

Triumph and Irish Cobbler gave the best yields of Irish potatoes. Fall planting yielded twice as much as spring planting and made larger and smoother tubers.

Sweet potatoes yielded 412 bushels to the acre. Harvesting October 20th nearly doubled the yield over September 20th harvesting.

Everbearing strawberries were in bearing this year from May 3rd until November 22nd. This is a decidedly successful crop in this section.

Approximately 3000 trees were grown from seed in the nursery this year. There are on hand 22,110 trees in the nursery rows for trial and distribution at the end of the year. Distribution was made this season of 1177 shade and ornamental trees.

Substation No. 9, Pecos:

Location: Three and one-half miles west of Pecos.
Latitude: 31 degrees north.
Longitude: 103 degrees west.
Elevation: 2580 feet above sea level.
Area: 80 acres.
Average rainfall for fifteen years: 10.81 inches.
Rainfall for 1920: 19.7 inches.
Number of experiments in 1920: 1265.

Variety tests with cotton using ten varieties gave yields ranging from 204 to 255 pounds lint cotton per acre, with Durango, Lone Star, and Snowflake leading in the order named. These varieties and Acala, which yielded 209 pounds of lint, gave staple ranging from $1^{1}/_{16}$ to $1^{3}/_{16}$

inches. Snowflake planted during the month of May gave desirable yields for each planting, but the June plantings gave very poor yields.

By prompt harvesting to protect it from the birds, grain sorghum yielded as high as 69 bushels per acre. June corn planted in June yielded 23 bushels per acre; but grain sorghums left in the field until they were thoroughly mature were practically destroyed by birds.

Dry beans and cowpea seed require comparatively little irrigation water and are desirable for this reason. Twenty varieties of cowpeas were tested. Red Ripper, Groit, and a hybrid led in production with yields of 11.7 bushels, 10.6 bushels, and 10.4 bushels seed per acre, respectively. A six-year average shows Chinese Yellow, Red Ripper, and Groit leading in yield of seed with Blackeye closely following. For four years the best yields have been from plantings made late in June.

The Tepary bean planted June 23rd yielded 18 bushels to the acre against an average of 13 bushels for two years. This bean seems well adapted to this section, but no extensive market has been developed for it as yet. One acre of frijoles produced 11 bushels of clean seed to the acre. There is an excellent market for this bean.

Alfalfa from seed grown locally at Barstow gave the highest yield in a test of ten varieties. Four-year-old alfalfa receiving 74 and 82 inches of water, respectively, yielded 6879 and 6870 pounds of cured hay, respectively.

In a variety test of ten of the best known grain sorghums the highest yields were made by Dwarf Hegari, 69 bushels per acre; Feterita, 69.2 bushels, and Dwarf Milo, 64.7 bushels per acre. Dwarf Hegari leads in a five-year average with 32.97 bushels per acre, and Milo leads in a three-year average with 33.93 bushels against Hegari with 33.10 bushels.

Texas Seeded Ribbon Cane yielded 13 tons of cured forage to the acre. A six-year average shows this variety yielding practically double as much forage as any other except Honey, which is the second best yielder. Excepting alfalfa, Sudan grass is the best hay crop grown on this Station. The Standard Broom Corn produced 814 pounds to the acre, leading in production the other three varieties tested.

Cantaloupes grown on this Station and in this vicinity have an enviable record for flavor and shipping qualities. Applications of 226 pounds of cottonseed meal gave the best results and abundantly justified the use of fertilizer. Applications of 113 pounds of cottonseed meal to the acre resulted in little or no benefit to the crop.

The pumping plant was operated 652 hours during the season at an estimated cost of $1011.50, including interest, depreciation, and repairs. A total of 1304 acre-inches of water was pumped at a cost of 77½ cents per acre-inch. These estimates include distribution and application of the water to the land.

In the past apparently on account of the alkaline nature of the soil the experiments in variety tests of orchard trees have shown that this location is very unfavorable for fruit production. Of 181 plantings made in 1920, 39 per cent. of the trees were dead in August.

Of 31 lots of forest and ornamental trees tested in the last three years in amounts ranging from one to 1000 individuals each, very few have been found to be at all suited to this soil. Of those which have some

promise, the following may be mentioned: *Poinciana pulchaerrina,* Tamarix, Russian Elm, *Catalpa speciosa,* Black Locust, Umbrella China, Chinese Arbor Vitae, *Thuya Aurea Nana,* Russian Mulberry, Chaste Tree, White Flowering Willow, Pink Flowering Willow, California Privet, and Amoor River Privet.

Substation No. 10, College Station; Feeding and Breeding Station:

Location: One mile northwest of College Station, on public highway.

Latitude: 30 degrees north.

Longitude: 96 degrees west.

Elevation: 308 feet above sea-level.

Area: Station-owned land, 265.8 acres; College land assigned to Station, 636 acres; total, 901.8 acres.

Average rainfall for 30 years: 37.35 inches annually.

Rainfall for 1920: 43.65 inches.

This substation is the central outdoor laboratory for the conduct of research in the feeding and breeding and management of farm animals. Certain feeding and breeding problems which are not local in their nature can best be studied at a point near the central or Main Station of the College, where intimate contact can be had with the numerous indoor research laboratories, including the chemical laboratory for the determination of analyses and the necessary indoor laboratory facilities for the study of soft pork. It is the policy to conduct at this substation researches of a nature that have general application to the entire State, whereas problems of a regional nature can best be attacked at the regional substations.

The results of the research conducted at this substation are reported in detail under the Division of Animal Industry.

Substation No. 11, Nacogdoches:

Location: Two and three-fourths miles north of Nacogdoches, in Nacogdoches County, on the Nacogdoches-Timpson highway.

Latitude: 32 degrees north.

Longitude: 94 degrees west.

Elevation: 292 feet above sea level.

Area: 82.5 acres.

Average rainfall for 20 years: 48.66 inches annually.

Rainfall for 1920: 52.33 inches.

Number of experiments in 1920: 714.

In the cotton variety test Acala led with a yield of 299 pounds of lint to the acre. Kasch was next with 259 pounds and Rowden next with 255.5 pounds.

In the cottonseed source test, seed from Spur yielded 337 pounds of seed cotton per acre, from Lubbock 316 pounds, from Nacogdoches 303 pounds, and from Temple 286 pounds. These are the average yields for the five years of this test.

In the corn variety test, Strawberry, Brazos White, and Hastings Prolific led in yield this year in the order named, but Surcropper leads in an average of the past three years.

Corn planted three feet apart in three-foot rows has outyielded corn

planted 18 inches apart in six-foot rows in an average of the past three years.

This was the third year of an experiment with planting cowpeas in corn at five different stages of growth of the corn. Results so far indicate that it is not desirable to plant the cowpeas until after the corn has reached a height of 36 inches, as the yield of the corn is reduced by earlier planting of the peas. When planted after the corn came into tassel neither plant appeared to influence the growth of the other.

In the cowpea variety test, a hybrid produced by crossing Iron and Whippoorwill led in seed yield, followed by Clay and Unknown. For the eight years of this test ten varieties have been compared and the present leaders in the producing rank are Clay, Unknown, and New Era in the order named. In the cowpea test for hay production, Groit, Brabham, and Red Ripper led in the order named, but in an average of the results for the last three years, Unknown, Brabham, and Groit lead in the order named.

In the watermelon variety test 13 varieties were grown with Watson, Kleckley's Sweet, and Golden Heart leading in the order named, though for the six years of this test Sweetheart, Phillip Jones, and Alabama Sweet lead in the order named. In the point of quality the round varieties, while earlier than the cylindrical varieties, are not as good, excepting the New Chilian which ranks in quality with the cylindrical-shaped melons. Considering both yield and quality, Kleckley's Sweet, Halbert Honey, and Watson lead in the order named.

In the cantaloupe variety test with 11 varieties, Hackensack, Ann Arundle, and Banana were outstanding in the order named as producers of weight of crop. Leading in production of number of fruits were Netted Rock King, Ann Arundle, and Rust Resistant Rocky Ford. During the six years of this experiment, Rocky Ford and Netted Rock show by far the best quality of meat and flavor. Eden Gem and Rust Resistant Rocky Ford are the highest yielders of that type for the period, while Hackensack is the highest yielder of its type.

The field work in the peanut improvement studies of the Division of Agronomy are conducted at this substation.

Substation No. 12, Chillicothe:

Location: Four and one-half miles south and one mile west of Chillicothe.

Latitude: 34 degrees north.

Longitude: 99 degrees west.

Elevation: 1406 feet above sea level.

Area: 100 acres.

Average rainfall for 15 years: 26.38 inches annually.

Rainfall for 1920: 39.69 inches.

The work here is conducted under the terms of a cooperative agreement with the Office of Forage Crop Investigations, Bureau of Plant Industry, United States Department of Agriculture. This substation is primarily a forage crops testing farm. During the year 647 different tests and experiments were conducted, of which 417 were with sorghums and sorghum-like plants. A total of 163 new introductions and selections of the sorghums were grown. In the sorghum variety test, con-

ducted since 1913, 16 varieties were used this year. The four highest yielders of forage in their order through the duration of the test are Honey, Gooseneck, White African, and Sumac. The four highest yielders of grain throughout the test period are Yellow Milo, Red Kaoliang, Darso, and feterita. Of the 163 newly introduced varieties and selections of sorghum grown, for comparison, 90 have been dropped and will not be tested further, three will be improved by selection, one will be put into variety test, 16 have been selected for drill plantings next year, and 53 will remain in this test for another year. In the pedigreed single plant selections of sorghums, 33 lots, including a number of hybrids, were grown in plats large enough to obtain the yield. A selection of feterita was the highest yielder, followed closely by another selection of feterita, and a dwarf kafir. A selection of Sumac gave the highest seed and the second highest forage yield of the sweet sorghums, Honey being the highest forage yielder. Several feterita-kafir hybrids yielded equally as well as the standard grain sorghums, and better than many of them, in both grain and forage. Four years' records comparing 40- and 80-inch rows for feterita and kafir, but with the same number of plants to the acre, indicates slightly higher yields for the 40-inch rows in both grain and forage, though kafir shows one-half bushel of grain to the acre in favor of the 80-inch rows. An eight-year test with Sudan grass points to 40 inches as the proper width of row. A seven-year average in the rate of seeding test for Sumac and Red Amber sorghums points to 60 pounds of seed to the acre as the most desirable rate of planting.

In the cotton variety test, a four-year record placed Acala, Durango, and Lone Star in the lead, respectively, in production. A two-year record comparing late and early thinning of cotton is favorable to the early thinning. The best rate of spacing is 18 inches in the row.

To test the contention that it pays to plant corn in this vicinity because corn yields well during seasonable years, corn and grain sorghums have been planted for yield comparison for two years. This was considered a good corn year, but the yield was only 16.74 bushels per acre against 23.24 bushels for the grain sorghum. Last year the corn yielded 8.45 bushels against 18.09 bushels per acre for the grain sorghum.

This was the second year of a test of wheat varieties for yield. Kanred made an average yield for the two years of 2.8 bushels per acre more than any of the other ten varieties in the test.

Results of an eight-year test with 20 varieties of cowpeas indicate that Early Buff yields the most seed and the least forage. New Era, Early Red, and Groit are shown to be the best general-purpose cowpeas in the order named.

Substation No. 14, Sonora; Angora Goat and Sheep Station:

Location: Twenty-six miles southeast of Sonora, in Sutton-Edwards Counties, on the Sonora-Rocksprings public road.

Latitude: 30 degrees north.

Longitude: 100 degrees west.

Elevation: 2400 feet above sea level (estimated).

Area: 3452 acres.

Average rainfall for three years: 27.0 inches annually.
Rainfall for 1920: 25.51 inches.

This substation is the special outdoor laboratory for the Angora goat and sheep-producing center of Southwest Texas, in which is produced nearly one-half of the entire clip of domestic mohair in the United States and which is a most important section for the production of wool, mutton, and chevon. It is also a typical region for the grazing of beef cattle. Certain problems in the production of range livestock are distinctly local in their nature and must be investigated in their local environment. This substation is located to meet this need and also to serve such general purposes as may be done incidentally.

The details of the investigational work conducted during the year are given under the Division of Veterinary Science, and the Division of Animal Industry.

COOPERATION

The Texas Station has official memoranda of cooperation, under which mutually agreeable and satisfactory research is being carried on, as follows:

(1) With the Office of Dry-Land Seed Distribution, United States Department of Agriculture, for co-operative work on the distribution of dry-land crops suitable to Texas conditions.

(2) With the Office of Forage Crops, United States Department of Agriculture, in the operation of Substation No. 12 at Chillicothe, and in general forage crops investigations throughout the State.

(3) With the Office of Foreign Seed and Plant Introduction, United States Department of Agriculture, for the introduction, propagation, and distribution of newly introduced plants which give promise of becoming valuable in Texas.

(4) With the Office of Cotton and Truck-Disease and Sugar-Plant Investigations, United States Department of Agriculture, for a general study of plant diseases in Texas, and for an annual plant disease survey in Texas.

(5) With the Office of Horticultural and Pomological Investigations, United States Department of Agriculture, for (a) the propagation and distribution of rosaceous fruits in Texas; (b) for the testing of Northern-grown seed of Irish potatoes in comparison with seed potatoes of local and State origin.

(6) With the Bureau of Soils, United States Department of Agriculture, for the conduct of soil survey work in Texas; the Division of Soil Survey being thus operated at this time.

(7) With the Bureau of Entomology, United States Department of Agriculture, for cooperative investigations of insects and external parasites affecting livestock.

(8) With the Bureau of Animal Industry, United States Department of Agriculture, for investigations as to the adaptability of the Corriedale sheep to Texas conditions.

(9) With the Bureau of Agricultural Economics, United States Department of Agriculture, for cooperative investigations in farm economics.

(10) With the Seed Laboratory, United States Department of Agriculture, for the testing of field and planting seeds; operation of branch seed laboratory in the Division of Agronomy.

(11) With the Office of Experiment Stations (formerly through the National Defense Council), in the prosecution of a study on the composting of raw rock phosphate and sulphur with different soils.

(12) With the Freeport Sulphur Company, Freeport, Texas, in the study of composting sulphur with different soils.

(13) With the Barrett Company of Texas, for cooperative investigations in rice improvement and methods of production.

(14) With the School of Agriculture, Agricultural and Mechanical College of Texas, wherein Station men may give lectures to students and teachers may do cooperative investigation work on the Station.

(15) With the School of Engineering, Agricultural and Mechanical College of Texas, wherein certain professors may cooperate in agricultural studies involving engineering problems.

(16) With the School of Veterinary Medicine, Agricultural and Mechanical College of Texas, whereby the Dean of the School of Veterinary Medicine acts as Chief of the Station's Division of Veterinary Science.

(17) With the Extension Service, Agricultural and Mechanical College of Texas, whereby the Extension workers from time to time suggest the more important problems confronting the farmers and stockmen of the State, and whereby certain Extension specialists cooperate with Station investigators in making investigations mutually agreed upon.

PUBLICATIONS

During the year the Station issued and distributed fourteen bulletins, six circulars, one annual report, and four press bulletins, a total of twenty-six publications. Of these, a total of 357,500 copies were printed, totaling 7,743,500 pages. A detailed list of the publications follows:

Bulletin No. and Title.	Number copies printed.	Total number pages in edition.
267 The Relation of the Phosphoric Acid of the Soil to Pot Experiments	3,000	159,000
268 Commercial Feeding Stuffs: September 1, 1919, to August 31, 1920	3,500	815,500
269 Grain Sorghums Versus Corn for Fattening Lambs	18,000	234,000
270 A Study of the Black and Yellow Molds of Ear Corn	10,000	380,000
271 The Salt or Sodium Chloride Content of Feeds	3,000	42,000
272 The Chemical Composition of Texas Honey and Pecans	7,000	63,000
273 Pink Root Disease of Onions and Its Control in Texas	4,000	168,000
274 Cotton Variety Experiments, Substation No. 3, Angleton, Texas.	10,000	100,000
275 Spur Feterita	25,000	700,000
276 Corn Variety Experiments, Substation No. 3, Angleton, Texas.	10,000	150,000
277 Sweet Potato Fertilizer Experiments at Substation No. 2, Troup Texas	25,000	175,000
278 Farm Tenantry in the United States	5,000	2,045,000
279 Type and Variability in Kafir	10,000	120,000
280 Commercial Fertilizers in 1920-1921	7,000	154,000

Bulletin No. and Title.	Number copies printed.	Total number pages in edition.
Circular No.		
24 Commercial Sulphur Products as Dormant Sprays for Control of the San Jose Scale	20,000	140,000
25 Management of Chickens on Texas Farms	25,000	350,000
26 Cost of Production; Its Relation to Price	30,000	330,000
27 The Screw Worm and Wool Maggot	12,000	168,000
28 Internal Parasites Affecting Sheep and Goats; Causes, Life-History, Symptoms, and Treatments	10,000	160,000
29 Dusting Cotton for the Control of the Boll Weevil	10,000	90,000
Annual Report.		
33d, for 1920	10,000	800,000
Press Bulletins.		
Four unnumbered, List of Publications Available for Distribution	100,000	400,000
Total—25	357,500	7,743,500

STATION LANDS

The following is a tabular statement of the lands owned and operated by the Texas Agricultural Experiment Station system in connection with investigational work:

Designation.	Total area in acres.	Acres in cultivation.	Acres in pasture.	Acres in farmstead, roadways, and miscellaneous.
Main Station, Agronomy Farm	127	98	11	18
Division of Veterinary Science	141	5	130	6
ubstations:				
No. 1	151.5	63.2	84.3	4
No. 2	150	50	90	10
No. 3	157	51	100	6
No. 4	100	60	10	30
No. 5	96	30	62	4
No. 6	203	163	37	3
No. 7	*406	104	*292	10
No. 8	160	109	41	10
No. 9	80	77.1	**0	2.9
No. 10	***901.8	212	674.8	15
No. 11	82.5	33.4	38.9	10.2
No. 12	100	80	10	10
No. 14	3452	65	3187	200
Total	6307.8	1200.7	4768	339.1

*Includes 246 acres leased for pasture.
**6.1 acres in cultivated pasture.
***Includes 636 acres of College land assigned to Experiment Station work.

FINANCIAL STATEMENT

A detailed statement of all funds devoted to the use of the Texas Agricultural Experiment Station system is given in the pages immediately following. The fiscal year for the State appropriations is for the period from September 1, 1920, to August 31, 1921, while the fiscal year for the Federal Hatch and Adams funds is for the period from July 1, 1920, to June 30, 1921, and the financial schedules which follow are based upon these designations of the fiscal year:

FUNDS AVAILABLE

From United States Treasurer for the year ending June 30, 1921, Hatch Fund	$ 15,000.00
From United States Treasurer for the year ending June 30, 1921, Adams Fund	15,000.00
From State Treasurer for the year ending August 31, 1921, Substations	81,730.00
From State Treasurer for the year ending August 31, 1921, Divisions	138,789.70
From Substation Treasury for the year ending August 31, 1921, Substation Treasury	46,677.89
From Main Station Treasury for the year ending August 31, 1921, Main Station Treasury	14,611.49
Total	$ 311,809.08

FEDERAL FUNDS

Hatch Fund.	Debit.	Credit.
Received from United States Treasurer	$ 15,000.00	
Salaries		$ 10,883.22
Labor		1,621.54
Postage and stationery		608.09
Freight and express		20.08
Chemicals and laboratory supplies		202.73
Seeds and plants		130.14
Fertilizers		6.00
Feedstuffs		3.50
Library		25.10
Farm machinery and implements		82.12
Furniture and fixtures		263.81
Livestock		152.29
Repairs on buildings		299.85
Total	$ 15,000.00	$ 15,000.00

Adams Fund.	Debit.	Credit.
Received from the United States Treasurer	$ 15,000.00	
Salaries		$ 10,652.60
Labor		2,323.07
Postage and stationery		24.78
Freight and express		112.81
Heat, light and water		39.42
Chemicals and laboratory supplies		705.38
Seeds and plants		365.05
Feedstuffs		132.45
Farm machinery and implements		30.91
Scientific apparatus		1,131.50
Livestock		57.64
Repairs on buildings		125.92
Total	$ 15,000.00	$ 15,000.00

STATE FUNDS

Substations (Appropriations).	Debit.	Credit.
Received from State Treasurer	$ 81,730.00	
No. 1. Beeville		$ 4,655.06
No. 2. Troup		5,270.00
No. 3. Angleton		5,375.00
No. 4. Beaumont		6,016.29
No. 5. Temple		4,847.60
No. 6. Denton		5,295.00
No. 7. Spur		4,988.74
No. 8. Lubbock		8,897.23
No. 9. Pecos		6,048.73
No. 10. Feeding and Breeding Station		11,692.28
No. 11. Nacogdoches		4,891.67
No. 12. Chillicothe		2,972.65
No. 14. Sonora		10,630.00
Balance unexpended (reverted to State Treasury)		149.75
Total	$ 81,730.00	$ 81,730.00

Divisions (Appropriations).	Debit.	Credit.
Received from State Treasurer	$ 138,789.70	
Salaries and General Expenses		$ 87,083.55
Veterinary Science		4,436.60
Horticulture		1,426.02
Animal Industry (College)		3,273.22
Animal Industry (Spur, Sonora)		2,700.00
Entomology		17,752.56
Agronomy		4,078.80
Agronomy Farm		4,100.00
Plant Pathology and Physiology		2,222.39
Forestry		1,500.00
Plant Breeding		1,973.62
Swine		1,600.00
Poultry		1,350.00
Dairy		1,650.00
Steer Feeding		2,000.00
Balance unexpended (reverted to State Treasury)		1,642.94
Total	$ 138,789.70	$ 138,789.70

Substation Treasury Funds (Sales)	Debit.	Credit.
Received from sales	$ 46,677.89	
No. 1. Beeville		$ 739.35
No. 2. Troup		736.66
No. 3. Angleton		452.51
No. 4. Beaumont		184.98
No. 5. Temple		216.85
No. 6. Denton		565.35
No. 7. Spur		1,279.50
No. 8. Lubbock		1,411.99
No. 9. Pecos		659.13
No. 10. Feeding and Breeding Station		3,081.76
No. 11. Nacogdoches		189.59
No. 12. Chillicothe		559.51
No. 14. Sonora		4,086.72
No. 10. Feeding and Breeding (old account)		16,052.62
Poultry		2,013.14
Swine		2,101.14
Dairy		5,740.02
Animal Industry (College)		2,330.18
Wool Scouring Plant		136.20
Soil Survey		1,838.45
General (Administrative)		1,986.22
Balance unexpended		316.02
Total	$ 46,677.89	$ 46,677.89

Main Station Treasury Funds (Sales)	Debit.	Credit.
Received from sales	$ 14,611.49	
Agronomy		$ 717.24
Entomology		184.49
Plant Breeding		125.97
Horticulture		119.50
Veterinary Science		935.00
Plant Pathology		2.97
Photographic		822.73
Chemical analyses		8,892.83
General (Administrative)		98.48
Banance unexpended		2,712.28
Total	$ 14,611.49	$ 14,611.49

CLASSIFICATION OF EXPENDITURES

(State Appropriations)

Salaries	$ 89,467.43
Labor	42,839.17
Postage and Stationery	5,412.60
Furniture and fixtures	2,025.28
Travel	6,580.47
Library	499.94
Exhibits	399.97
Publications	7,432.09
Soil survey	7,492.40
Fuel	1,326.50
Farm machinery and implements	2,593.85
Chemical and laboratory supplies	2,929.32
Feedstuffs	1,065.17
Seeds and plants	1,726.91
Scientific apparatus	803.07
Livestock	1,450.00
Experimental apiaries	13,567.74
Fertilizers	150.00
Repairs on buildings	21,396.83
Miscellaneous	9,568.27
Balance unexpended	1,792.69
Total	$ 220,519.70

SUMMARY

State appropriations (Substations)	$ 81,730.00
State appropriation (Divisions)	138,789.70
Total	$ 220,519.70

INVENTORIES.

	Value.
Substations.	
No. 1. Beeville	$ 24,714.58
No. 2. Troup	33,728.75
No. 3. Angleton	20,221.67
No. 4. Beaumont	20,522.50
No. 5. Temple	29,253.21
No. 6. Denton	47,112.98
No. 7. Spur	33,002.13
No. 8. Lubbock	27,717.98
No. 9. Pecos	34,785.28
No. 10. Feeding and Breeding Station	106,918.27
No. 11. Nacogdoches	22,463.33
No. 12. Chillicothe	21,917.93
No. 14. Sonora	97,317.30
Total	$ 519,675.91
Divisions.	
Veterinary Science	$ 21,209.17
Horticulture	4,472.67
Entomology	11,394.10
Plant Pathology and Physiology	5,459.18
Plant Breeding	3,126.73
Agronomy	29,422.92
Animal Industry	17,514.22
Forestry	10.10
Chemistry	8,094.89
Feed Control Service	2,380.87
Farm and Ranch Economics	327.70
Photographic	1,042.72
Soil Survey	1,572.50
General (Administrative)	26,916.83
Total	$ 132,944.60

SUMMARY

	Value.
Total valuation of Substation properties	$ 519,675.91
Total valuation of Division properties	132,944.60
Total	$ 652,620.51

FEED CONTROL SERVICE

	Debit.	Credit.
Tax collected (inspection tax tags)	$ 76,276.90	
Salaries		$ 19,349.71
Labor		1,537.30
Postage and stationery		1,472.18
Office supplies		202.54
Freight and express		215.27
Travel (inspectors)		6,620.47
Furniture and fixtures		143.00
Tags		26,367.34
Printing of tags		1,075.13
Refund of tags		739.76
Repairs on buildings		457.84
Publications		6,998.34
Analyses		8,336.33
Surplus (net)		2,761.69
Total	$ 76,276.90	$ 76,276.90

SUMMARY

	Debit.	Credit.
Working fund	$ 10,000.00	
Inventory tax tags on hand	5,081.10	
C. O. D. Outstanding uncollected	1,400.45	
Gross surplus		$ 16,481.55
Total	$ 16,481.55	$ 16,481.55

COLLEGE STATION, TEXAS, August 31, 1921.

Director B. Youngblood, College Station, Texas.

DEAR SIR: I do solemnly swear that the foregoing report upon the receipts and disbursements of the several funds devoted to development, maintenance and the support of the Texas Agricultural Experiment Station and its thirteen (13) substations, is just and correct, and that the funds have been expended in accordance with the Federal and State laws, to the best of my knowledge and belief.

(Signed) CHAS. A. FELKER,
Chief Clerk.

Subscribed to and sworn before me, A. S. Ware, a notary public in and for Brazos County, Texas, on the 31st day of August, A. D., 1921.

(Signed) A. S. WARE,
(Seal) Notary Public in and for Brazos County, Texas.